

EVERYDAY
ELECTRONICS

MARCH 1992

INCORPORATING ELECTRONICS MONTHLY

£1.60

FREE
INSIDE
MARCO

32 PAGE SPRING
CATALOGUE

Special

**GET YOU THROUGH
WINTER ISSUE**

**EMERGENCY PLUGLIGHT
CYCLE LIGHT BACK-UP
ECONOMY SEVEN TIMER
AUTO GARAGE LIGHT**



THE No. 1 INDEPENDENT MAGAZINE for ELECTRONICS, TECHNOLOGY and COMPUTER PROJECTS

AMSTRAD PORTABLE PC'S FROM £149 (PPC1512SD), £179 (PPC1512DD), £179 (PPC1640SD), £209 (PPC1640DD). MODEMS £30 EXTRA. NO MANUALS OR PSU.

HIGH POWER CAR SPEAKERS. Stereo pair output 100w each. 4ohm impedance and consisting of 6 1/2" woofer 2" mid range and 1" tweeter. Ideal to work with the amplifier described above. Price per pair £30.00 Order ref 30P7R

2KV 500 WATT TRANSFORMERS Suitable for high voltage experiments or as a spare for a microwave oven etc. 250v AC input. £10.00 ref 10P93R

MICROWAVE CONTROL PANEL. Mains operated, with touch switches. Complete with 4 digit display, digital clock, and 2 relay outputs one for power and one for pulsed power (programmable). Ideal for all sorts of precision timer applications etc. £6.00 ref 6P18R

FIBRE OPTIC CABLE. Stranded optical fibres sheathed in black PVC. Five metre length £7.00 ref 7P29R

12V SOLAR CELL. 200mA output ideal for trickle charging etc. 300 mm square. Our price £15.00 ref 15P42R

PASSIVE INFRA-RED MOTION SENSOR. Complete with daylight sensor, adjustable lights on timer (8 secs -15 mins), 50' range with a 90 deg coverage. Manual override facility. Complete with wall brackets, bulb holders etc. Brand new and guaranteed. £25.00 ref 25P24R. Pack of two PAR38 bulbs for above unit £12.00 ref 12P43R

VIDEO SENDER UNIT Transmit both audio and video signals from either a video camera, video recorder or computer to any standard TV set within a 100' range! (tune TV to a spare channel). 12v DC op. £15.00 ref 15P39R Suitable mains adaptor £5.00 ref 5P191R

FM TRANSMITTER housed in a standard working 13A adapter (bug is mains driven). £26.00 ref 26P2R

MINIATURE RADIO TRANSCEIVERS A pair of walkie talkies with a range of up to 2 kilometres. Units measure 22x52x155mm. Complete with cases. £30.00 ref 30P12R

FM CORDLESS MICROPHONE. Small hand held unit with a 500' range! 2 transmit power levels reqs PP3 battery. Tuneable to any FM receiver. Our price £15 ref 15P42AR

12 BAND COMMUNICATIONS RECEIVER. 9 short bands, FM, AM and LW DX/local switch, tuning 'eye' mains or battery. Complete with shoulder strap and mains lead. **NOW ONLY £19.00!! REF 19P14R.**

WHISPER 2000 LISTENING AID. Enables you to hear sounds that would otherwise be inaudible! Complete with headphones. Cased. £5.00 ref 5P179R

CAR STEREO AND FM RADIO. Low cost stereo system giving 5 watts per channel. Signal to noise ratio better than 45db, wow and flutter less than .35%. Neg earth. £25.00 ref 25P21R

LOW COST WALKIE TALKIES. Pair of battery operated units with a range of about 200'. Our price £8.00 a pair ref 8P50R

7 CHANNEL GRAPHIC EQUALIZER. plus a 60 watt power amp! 20-21KHz 4-8R 12-14v DC negative earth. Cased. £25 ref 25P14R

NICAD BATTERIES. Brand new top quality. 4 x AA's £4.00 ref 4P44R. 2 x C's £4.00 ref 4P73R, 4 x D's £9.00 ref 9P12R, 1 x PP3 £6.00 ref 6P35R

TOWERS INTERNATIONAL TRANSISTOR SELECTOR GUIDE. The ultimate equivalents book. Latest edition £20.00 ref 20P32R

CABLE TIES. 142mm x 3.2mm white nylon pack of 100 £3.00 ref 3P104R. Bumper pack of 1,000 ties £14.00 ref 14P6R

1992 CATALOGUE AVAILABLE NOW
IF YOU DO NOT HAVE A COPY PLEASE REQUEST ONE WHEN ORDERING OR SEND US A 6"x9" SAE FOR A FREE COPY.

GEIGER COUNTER KIT. Complete with tube, PCB and all components to build a battery operated geiger counter. £39.00 ref 39P1R

FM BUG KIT. New design with PCB embedded coil. Transmits to any FM radio. 9v battery req'd. £5.00 ref 5P158R

FM BUG Built and tested superior 9v operation £14.00 ref 14P3R

COMPOSITE VIDEO KITS. These convert composite video into separate H sync, V sync and video. 12v DC. £8.00 ref 8P39R

SINCLAIR C5 MOTORS 12v 29A (full load) 3300 rpm 6"x4" 1/4" O/P shaft. New. £20.00 ref 20P22R

As above but with fitted 4 to 1 inline reduction box (800rpm) and toothed nylon belt drive cog £40.00 ref 40P8R

SINCLAIR C5 WHEELS 13" or 16" dia including treaded tyre and inner tube. Wheels are black, spoked one piece poly carbonate. 13" wheel £6.00 ref 6P20R, 16" wheel £6.00 ref 6P21R

ELECTRONIC SPEED CONTROL KIT for c5 motor. PCB and all components to build a speed controller (0-95% of speed). Uses pulse width modulation. £17.00 ref 17P3R

SOLAR POWERED NICAD CHARGER. Charges 4 AA nicads in 8 hours. Brand new and cased £6.00 ref 6P3R.

12 VOLT BRUSHLESS FAN. 1/2" square brand new ideal for boat, car, caravan etc. £5.00 ref 5P206

ACORN DATA RECORDER ALF503 Made for BBC computer but suitable for others. Includes mains adaptor, leads and book. £15.00 ref 15P43R

VIDEO TAPES. Three hour superior quality tapes made under licence from the famous JVC company. Pack of 10 tapes £20.00 ref 20P20R

PHILIPS LASER. 2MW HELIUM NEON LASER TUBE. BRAND NEW FULL SPEC £40.00 REF 40P10R. MAINS POWER SUPPLY KIT £20.00 REF 20P33R READY BUILT AND TESTED LASER IN ONE CASE £75.00 REF 75P4R.

6V 10AH LEAD ACID sealed battery by yuasa ex equipment but in excellent condition now only 2 for £10.00 ref 10P95R.

12 to 220v INVERTER KIT As supplied it will handle up to about 15 w at 220v but with a larger transformer it will handle 80 watts. Basic kit £12.00 ref 12P17R. Larger transformer £12.00 ref 12P41R.

VERO EASI WIRE PROTOTYPING SYSTEM Ideal for designing projects on etc. Complete with tools, wire and reusable board. Our price £6.00 ref 6P33R

MICROWAVE TURNTABLE MOTORS. Ideal for window displays etc. £5.00 ref 5P165R

SWITCH MODDED POWER SUPPLY 220v or 110v input giving 5v at 2A, +24v at 0.25A, +12v at 0.15A and +90v at 0.4A £6.00 ref 6P59R

HIGH RESOLUTION 12" AMBER MONITOR 12v 1.5A Hercules compatible (TTL input) new and cased £22.00 ref 22P2R

VGA PAPER WHITE MONO monitors new and cased 240v AC. £59.00 ref 59P4R

25 WATT STEREO AMPLIFIER. c. STK043. With the addition of a handful of components you can build a 25 watt amplifier. £4.00 ref 4P69R (Circuit dia included).

LINEAR POWER SUPPLY Brand new 220v input +5 at 3A, +12 at 1A, -12 at 1A. Short circuit protected. £12.00 ref 12P21R

MINI RADIO MODULE Only 2" square with ferrite aerial and tuner. Superhet. Req's PP3 battery. £1.00 ref BD716R

BARGAIN NICADS AAA SIZE 200MAH 1.2V PACK OF 10 £4.00 REF 4P92R, PACK OF 100 £30.00 REF 30P16R

FRESNEL MAGNIFYING LENS 83 x 52mm £1.00 ref BD827R

ALARM TRANSMITTERS. No data available but nicely made complex transmitters 9v operation. £4.00 each ref 4P81R

UNIVERSAL BATTERY CHARGER. Takes AA's, C's, D's and PP3 nicads. Holds up to 5 batteries at once. New and cased, mains operated. £6.00 ref 6P36R.

COLOUR MONITORS

AMSTRAD CTM644

RGB INPUT

£75.00 REF A75P1

RESISTOR PACK. 10 x 50 values (500 resistors) all 1/4 watt 2% metal film. £5.00 ref 5P170R

CAPACITOR PACK 1.100 assorted non electrolytic capacitors £2.00 ref 2P286R

CAPACITOR PACK 2. 40 assorted electrolytic capacitors £2.00 ref 2P287R

QUICK CUPPA? 12v immersion heater with lead and cigar lighter plug £3.00 ref 3P92R

LED PACK. 50 red leds, 50 green leds and 50 yellow leds all 5mm £8.00 ref 8P52R

FERRARI TESTAROSSA. A true 2 channel radio controlled car with forward, reverse, 2 gears plus turbo. Working headlights. £22.00 ref 22P6R

MIRACOM WS4000 MODEMS

V21/23

AT COMAND SET

AUTODIAL/AUTOANSWER

FULL SOFTWARE CONTROL

STONE AND PULSE DIALLING

£29

PIR LIGHT SWITCH Replaces a standard light switch in seconds light operates when anybody comes within detection range (4m) and stays on for an adjustable time (15 secs to 15 mins). Complete with daylight sensor. Unit also functions as a dimmer switch! 200 watt max. Not suitable for fluorescents. £14.00 ref 14P10R

CUSTOMER RETURNED 2 channel full function radio controlled cars only £8.00 ref 8P200R

WINDUP SOLAR POWERED RADIO! FM/AM radio takes rechargeable batteries complete with hand charger and solar panel 14P200R

240 WATT RMS AMP KIT Stereo 30-0-30 psu required £40.00 ref 40P200R

300 WATT RMS MONO AMP KIT £55.00 Psu required ref 55P200

ALARM PIR SENSORS Standard 12v alarm type sensor will interface to most alarm panels. £16.00 ref 16P200

ALARM PANELS 2 zone cased keypad entry, entry exit time delay etc. £18.00 ref 18P200

MODEMS FOR THREE POUNDS!! Fully cased UK modems designed for dial up system (PSTN) no data or info but only £3.00 ref 3P145R

TELEPHONE HANDSETS Bargain pack of 10 brand new handsets with mic and speaker only £3.00 ref 3P146R

BARGAIN STRIPPERS Computer keyboards. Loads of switches and components excellent value at £1.00 ref CD40R

PC POWER SUPPLIES These units are new but need attention complete with case, fan IEC

BULL ELECTRICAL

250 PORTLAND ROAD HOVE SUSSEX

BN3 5QT TELEPHONE 0273 203500

MAIL ORDER TERMS: CASH PO OR CHEQUE

WITH ORDER PLUS £3.00 POST PLUS VAT.

PLEASE ALLOW 7 - 10 DAYS FOR DELIVERY

NEXT DAY DELIVERY £8.00

FAX 0273 23077



input plug disc drive and mother board fly leads. Our price is £5.00 (less than the fan alone would cost!) ref 5P208R

HIGH VOLTAGE CAPACITORS A pack of 20 500PF 10KV capacitors ideal for ionizers TV repairs and high voltage experiments etc. Price is £2.00 ref 2P378R

DATA RECORDERS Customer returned mains battery units built in mic ideal for Computer or general purpose audio use. Price is £4.00 ref 4P100R

SPECTRUM JOYSTICK INTERFACE Plugs into 48K Spectrum to provide a standard Atari type joystick port. Our price £4.00 ref 4P101R

ATARI JOYSTICKS Ok for use with the above interface, our price £4.00 ref 4P102R

BENCH POWER SUPPLIES Superbly made fully cased (metal) giving 12v at 2A plus a 6V supply. Fused and short circuit protected. For sale at less than the cost of the case! Our price is £4.00 ref 4P103R

SPEAKER WIRE Brown twin core insulated cable 100 feet for £2.00 REF 2P79R

MAINS FANS Brand new 5" x 3" complete with mounting plate quite powerful and quite. Our price £1.00 ref CD41R

DISC DRIVES Customer returned units mixed capacities (up to 1.44M) We have not sorted these so you just get the next one on the shelf. Price is only £7.00 ref 7P1R (worth it even as a stripper)

HEX KEYBOARDS Brand new units approx 5" x 3" only £1.00 each ref CD42R

PROJECT BOX 51/2" x 31/2" x 1" black ABS with screw on lid. £1.00 ref CD43R

SCART TO SCART LEADS Bargain price leads at 2 for £3.00 ref 3P147R

SCART TO D TYPE LEADS Standard Scart on one end, Hi density D type on the other. Pack of ten leads only £7.00 ref 7P2R

OZONE FRIENDLY LATEX 250ml bottle of liquid rubber sets in 2 hours. Ideal for mounting PCB's fixing wires etc. £2.00 each ref 2P379R

QUICK SHOTS Standard Atari compatible hand controller (same as joysticks) our price is 2 for £2.00 ref 2P380R

VIEWDATA SYSTEMS Brand new units made by TANDATA complete with 1200/75 built in modem infra red remote controlled qwerty keyboard BT approved Prestel compatible, Centronics printer port RGB colour and composite output (works with ordinary television) complete with power supply and fully cased. Our price is only £20.00 ref 20P1R

3 INCH DISCS Ideal for Amstrad PCW and Spectrum +3 machines pack of 10 discs is £12.00 ref 12P1R

AC STEPDOWN CONVERTOR Cased units that convert 240v to 110v 3" x 2" with mains input lead and 2 pin American output socket (suitable for resistive loads only) our price £2.00 ref 2P381R

SPECTRUM +3 LIGHT GUN PACK complete with software and instructions £8.00 ref 8P58R

CURLY CABLE Extends from 8" to 6 feet! D connector on one end, spade connectors on the other ideal for joysticks etc (6 core) £1.00 each ref CD44R

COMPUTER JOYSTICK BARGAIN Pack of 2 joysticks only £2.00 ref 2P382R

MINI MONO AMPLIFIER PACK 4 amplifiers for £2.00! 3 watt units 9-12v operation ideal for experiments etc £2.00 ref 2P383R

BUGGING TAPE RECORDER Small hand held cassette recorders that only operate when there is sound then turn off 6 seconds after so you could leave it in a room all day and just record any thing that was said. Price is £20.00 ref 20P3R

IEC MAINS LEADS Complete with 13A plug our price is only £3.00 for TWO! ref 3P148R

COMPUTER SOFTWARE BARGAIN 10 cassettes with games for commodore 64, Spectrum etc. Our bargain price one pound! ref CD44R

NEW SOLAR ENERGY KIT Contains 8 solar cells, motor, tools, fan etc plus educational booklet. Ideal for the budding enthusiast! Price is £12.00 ref 12P2R

FUSE PACK NO 1 Fifty fuses 1 1/4" long (glass) quick blow 10 popular values £2.00 ref 2P384R

FUSE PACK NO 2 Fifty fuses 20mm long (glass) quick blow 10 popular values £2.00 ref 2P385R

POTENTIOMETER PACK NO 1 30 pots for £3.00! Ideal for projects etc. Ref CD45R

286 AT PC

286 MOTHER BOARD WITH 640K RAM FULL SIZE METAL CASE, TECHNICAL MANUAL, KEYBOARD AND POWER SUPPLY £139 REF 139P1 (no i/o cards or drives included)

35MM CAMERAS Customer returned units with built in flash and 28mm lens 2 for £8.00 ref 8P200

STEAM ENGINE Standard Mamod 1332 engine complete with boiler piston etc £30 ref 30P200

TALKING CLOCK LCD display, alarm, battery operated. Clock will announce the time at the push of a button and when the alarm is due. The alarm is switchable from voice to a cock crowing! £14.00 ref 14P200R

HANDHELD TONE DIALERS Small units that are designed to hold over the mouth piece of a telephone to send MF dialling tones. Ideal for the remote control of answer machines. £5.00 ref 5P209R

COMMODORE 64 MICRODRIVE SYSTEM Complete cased brand new drives with disc and software 10 times faster than tape machines works with any Commodore 64 setup. The original price for these was £49.00 but we can offer them to you at only £25.00! Ref 25P1R

USED SCART PLUGS Pack of 10 plugs suitable for making up leads only £5.00 ref 5P209R

C CELL SOLAR CHARGER Same style as our 4 x AA charger but holds 2 C cells. Fully cased with flip top lid. Our price £6.00 ref 6P79R



EVERYDAY ELECTRONICS

INCORPORATING ELECTRONICS MONTHLY

ABC

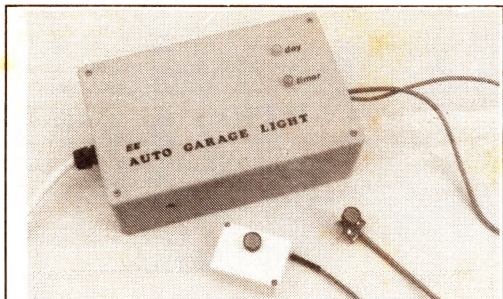
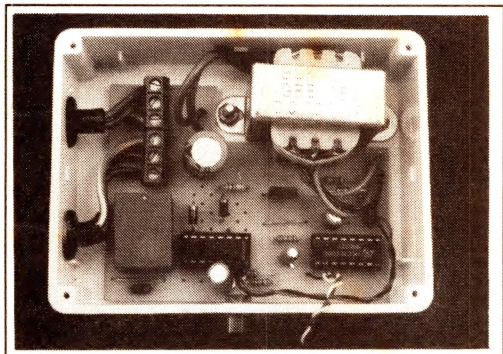
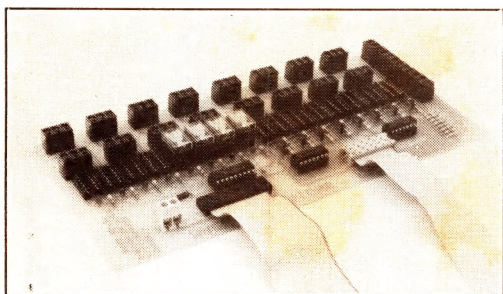
MEMBER OF THE ASSOCIATION OF ELECTRONIC PUBLISHERS

VOL. 21 No. 3 MARCH 1992

**The No. 1 Independent Magazine for Electronics,
Technology and Computer Projects**

ISSN 0262 3617

PROJECTS... THEORY... NEWS...
COMMENT... POPULAR FEATURES...



© Wimborne Publishing Ltd 1992. Copyright in all drawings, photographs and articles published in **EVERYDAY ELECTRONICS** is fully protected, and reproduction or imitations in whole or in part are expressly forbidden.

Our April '92 Issue will be published on
Friday, 6 March 1992. See page 131 for details.

Projects

- | | |
|--|------------|
| EMERGENCY PLUG LIGHT by Ivor Sadler | 138 |
| Comes on when the mains goes off, doubles as a rechargeable torch | |
| ECONOMY SEVEN TIMER by Chris Brown | 142 |
| Use your appliances on cheap rate electricity | |
| AUTO GARAGE LIGHT by A. R. Winstanley | 154 |
| Turns the light on when it sees your car headlights | |
| CYCLE LIGHT BACKUP by T. R. de Vaux Balbirnie | 170 |
| Keeps the lights on when the dynamo stops turning | |
| VERSATILE BBC INTERFACE by Mark Stuart | 176 |
| Eight programmable input/output lines plus eight output lines all with relay switching if required | |

Series

- | | |
|--|------------|
| INFORMATION TECHNOLOGY AND THE NATIONAL CURRICULUM by T. R. de Vaux-Balbirnie | 146 |
| Part Five: Microelectronic Experiments. | |
| INTERFACE by Robert Penfold | 160 |
| The place for computer fans – controlling d.c. motors | |
| MAGNETIC RECORDING by Vivian Capel | 162 |
| Part Six: Recording Tape | |
| AMATEUR RADIO by Tony Smith G4FAI | 168 |
| Listening on v.h.f.; Loft Antennas; Cable Problems; More Novices | |
| ACTUALLY DOING IT by Robert Penfold | 174 |
| Screening and screened leads | |

Features

- | | |
|---|------------|
| EDITORIAL | 137 |
| FOR YOUR ENTERTAINMENT by Barry Fox | 144 |
| Double Coated; Jukebox Technology; Fax Killer | |
| EVERYDAY NEWS | 152 |
| What's happening in the world of electronics | |
| ANIMATED CIRCUITS FOR ELECTRONICS | 166 |
| Mike Tooley reviews a novel software package | |
| SHOPTALK with David Barrington | 181 |
| Component buying for projects | |
| PLEASE TAKE NOTE | 181 |
| MARC System chip-encoder | |
| DOWN TO EARTH by George Hylton | 182 |
| Fault Finding | |
| DIRECT BOOK SERVICE | 184 |
| Selected technical books and all the EE books by mail order | |
| PRINTED CIRCUIT BOARD SERVICE | 188 |
| P.C.B.s for EE projects past and present | |

- | | |
|---|----------------------|
| FREE WITH THIS ISSUE | Between pages |
| MARCO TRADING CATALOGUE SUPPLEMENT | 160 and 161 |
| ADVERTISER'S INDEX | 192 |

Readers Services • Editorial and Advertisement Departments 137

HARD DISC DRIVES

20 Mb (IDE - CONNER)	£ 79
20 Mb (MFM)	£ 79
40 Mb (IDE)	£ 140
100 Mb (IDE - CONNER)	£235
MOUNTING KIT	£ 9
MOUNTING KIT (RAILS ONLY)	£ 5

HARDCARDS

20 Mb AT	£105
20 Mb XT	£125
40 Mb AT	£170
40 Mb XT	£185
IDEAL FOR 1512 / 1640 COMPUTERS	

FLOPPY DISC DRIVES

3½" 1.44M INTERNAL - GREY	£ 40
3½" 1.44M INTERNAL - BLACK	£ 35
3½" 720K INTERNAL - GREY	£ 33
3½" 720K EXTERNAL - GREY	£ 26
5¼" 360K INTERNAL - GREY	£ 24
5¼" 360K INTERNAL - BLACK	£ 24
5¼" 1.2M INTERNAL - GREY	£ 45

MONITORS

TILT & SWIVEL BASES ON ALL MONITORS

14" SVGA+ MULTISYNC	£ 270
14" SVGA+ / XVGA	£ 235
ALL SVGA+ ARE COLOUR 0.28" DOT PITCH - 1024 x 768	
14" VGA COLOUR	£185
14" VGA PAPER WHITE	£ 89
12" VGA PAPER WHITE	£ 79

GRAPHIC CARDS

CGA CARD	COMPOSITE & TTL	£ 12
VGA CARD	8 OR 16 BIT - 256K	£ 43
SVGA CARD	16BIT - 512K	£ 60
SVGA CARD	16BIT - 1M	£ 72

COMPUTER CASES

WITH 200W P.S.U AND L.E.D.DISPLAY

FLIP-TOP	3 BAYS-NO DISPLAY	£ 60
DESKTOP	3 BAYS+1 HIDDEN	£ 70
MINI TOWER	4 BAYS+1 HIDDEN	£ 70
MIDI TOWER	5 BAYS+1 HIDDEN	£ 107
FULL TOWER	6 BAYS+1 HIDDEN	£ 123

**LET HOBBYKIT QUOTE FOR
YOUR COMPUTER SYSTEM**

DOS SYSTEMS

MS DOS 5.0	£ 62
DR DOS 6.0	£ 65

ALL PRICES ARE SUBJECT TO CHANGE WITHOUT PRIOR NOTICE

CONTROLLER CARDS

IDE - AT 16BIT-2HDD/2FDD	£ 17
IDE - AT 16BIT-2HDD/2FDD/2S/1P/1G	£ 26
IDE - 8 BIT-XT	£ 29
IDE - 8 BIT-SLAVE / 1ST OR 2ND HDD	£ 39
IDE - AS ABOVE-16 BIT-WORKS WITH MFM	£ 45
XT - MFM - 8 BIT - 2 HDD ONLY	£ 38
AT RLL - 2 x HDD	£ 25
AT MFM - 2 x HDD / 2 x FDD	£ 44
AT RLL - 2 x HDD / 2 x FDD	£ 40
FDD - 2 x FDD - XT/AT - ALL FORMATS	£ 27
FDD - 4 x FDD - XT/AT - ALL FORMATS	£ 39
I/O CARD - 2S / 1P / 1G	£ 16
IDEAL FOR 1512 / 1640 COMPUTERS	

MOTHERBOARDS

★ COMPLETE WITH 1 Mb MEMORY ★

286 - 16	L/S 21 MHz	£ 105
286 - 20	L/S 25 MHz	£ 125
286 - 25	L/S 32 MHz	£ 145
386SX - 16	L/S 21 MHz	£ 190
386SX - 25	L/S 31 MHz	£ 225
386SX - 25	WITH 32K CACHE	£ 298
386DX - 33	WITH 64K CACHE	£ 407
486DX - 33	WITH 64K CACHE	£ 786

OTHER 386 / 486 MOTHERBOARDS - PLEASE CALL

SPECIAL OFFER 286 - 16 SYSTEM

● FEATURES INCLUDE ●

- 286-16 (L/S 21MHZ)
- 1 Mb ON BOARD MEMORY
- 20 Mb HARD DISC IDE
- 3½" 1.44M FLOPPY
- HDD / FDD CONTROLLER
- 2S / 1P / 1G
- GRAPHICS CARD VGA = 256K SVGA = 512K
- KEYBOARD (102 KEYS)
- MINI TOWER CASE
- CHOICE OF MONITOR

12" VGA PAPER WHITE	£ 460
14" VGA PAPER WHITE	£ 495
14" VGA COLOUR	£ 585
14" SVGA+/ XVGA COLOUR	£ 640

HOBBYKIT

CREDIT CARD HOTLINE

☎ 081 - 205 7485

UNIT 19 CAPITOL INDUSTRIAL PARK
CAPITOL WAY, LONDON, NW9 0EQ
FAX NUMBER : 081 - 205 0603

JUST ARRIVED

INTEGRATED FAX / MODEM CARD

9600BPS FAX
SEND & RECEIVE FAX - G3 COMPATIBLE
2400BPS MODEM
HAYES COMPATIBLE - MNPS, V.42 DATA
COMPRESSION AND ERROR CORRECTION
R 9624FM £150

MODEMS

INTERNAL MODEM - V22 BIS - 2400 BPS
AUTO DIAL / REDIAL / ANSWER - FULL DUPLEX
TONE & PULSE DIAL - BT & BABT APPROVED
SUPPLIED WITH EAZILINK COMMS PACKAGE
MC2400 - INTERNAL £ 65

EXTERNAL MODEM - V22 BIS - 2400 BPS
AUTO DIAL / REDIAL / ANSWER - FULL DUPLEX
HAYES COMPATIBLE - TONE & PULSE DIAL
COM 1 / 4 SELECTABLE - AUTO DIAGNOSTICS
STATUS LED's - MAINS ADAPTER
SUPPLIED WITH EAZILINK COMMS PACKAGE
LC8824 - EXTERNAL £ 95

INPUT DEVICES

AT 102 KEY - UK - IBM CLICK	£24
MOUSE - 3 BUTTON GENIUS MOUSE / MAT ADAPTOR / MENU MAKER OR GENIUS SOFTWARE / HOLDER	£20
JOYSTICK - IBM COMPATIBLE	£20

●● ALL PRICES
INCLUDE V A T ●●

ACCESSORIES

5¼" ADAPTOR KIT FOR 3½" FDD	£ 8.00
5¼" TRAY FOR 3½" FDD	£ 5.50
POWER LEAD FOR 3½" FDD	£ 3.00
IDC PIN TO EDGE CONNECTOR PCB	£ 4.00
SHORT F D D CONTROLLER CABLE 2'	£ 4.00
LONG F D D CONTROLLER CABLE 4'	£ 7.00
POWER SPLITTER	£ 4.50
HARD DRIVE CABLES (MFM/RLL)	£ 6.00
IDE HARD DRIVE CABLE (2 DRIVES)	£ 6.00
KEYBOARD EXTENSION CABLE	£ 3.00
4 MB RAM EXPANSION BOARD (0 RAM)	£62.00

FDD EXTERNAL CASES

METAL GREY CASE SUITABLE FOR EXTERNAL
MOUNTING OF FLOPPY DISC DRIVES

5¼" CASE ONLY	£ 8
5¼" CASE + LEADS FOR F D D	£ 17
3½" CASE ONLY	£ 8
3½" CASE + LEADS FOR F D D	£ 20

**PLEASE ADD £ 3.00 TO ALL
ORDERS TO COVER POSTAGE**

AUDIO TELESCOPE

An audio device, which simply amplifies sounds so that weak sounds can be heard more clearly. A sort of audio equivalent to a telescope in fact, or it could be regarded as a hearing aid, but for those with healthy hearing. The output of the unit feeds a pair of personal stereo type headphones.

VERSATILE AUDIO AMPLIFIER

An inexpensive hybrid amplifier designed as a general purpose power amp. The unit can be supplied with d.c. from 9V to 35V and will give up to 80W output.

EASY SWITCH

This circuit was originally designed to replace the standard switch on an elderly person's electric lawn mower. Due to arthritis, he was unable to maintain sufficient hand pressure to keep it on.

Many lawn mowers have a switch which requires quite a large hand pressure – even people with normal hands can find it difficult keeping it pressed for long periods. This electronic replacement solves the problem.

CIRCUIT SURGERY

Our new clinic especially for Everyday Electronics' constructors. Circuit Surgery aims to provide a regular cocktail of practical hints and tips. It also intends to act as a "self-help" forum for readers as well as a means of providing rapid feedback (including modifications and trouble-shooting information) on the projects which appear in Everyday Electronics. For good measure, we also hope to put paid to some popular myths and misconceptions. This column will rely heavily on your input!



EVERYDAY ELECTRONICS

APRIL ISSUE ON SALE FRIDAY 6TH MARCH 1992

EXTENDED



**FREE
GREENWELD
32 page spring
catalogue
supplement**

ANTEX

Soldering Kits make it easy.



Antex soldering kits have been specially produced to give hobbyists and electronic enthusiasts the perfect tools for a wide range of soldering jobs. The kits include a compact iron, handy soldering stand, a pack of solder and a complete booklet guide to soldering.

There are four different kits to suit your particular needs. Each bit contains a thermally balanced Antex Soldering Iron (different wattage according to kit), for which a wide range of soldering bits are available. 18 and 25 watt versions include a combined hook and finger protector. The MLXS contains a 12 volt iron with long 3 1/2m lead and croc-clips for field, hobby, boat or caravan use.

4
DIFFERENT
KITS
AVAILABLE

Available from leading electronic shops and distributors.

Complete your tools with Antex Soldering Irons.

ANTEX

Antex Electronics 2 Westbridge Industrial Estate,
Tavistock, Devon PL19 8DE Telephone: (0822) 613565
Fax: (0822) 617598

electronize kits

MICRO-PRESSURE CAR ALARM

- ★ Unique air pressure sensing system.
- ★ Operates on all doors and tailgate - no switches needed.
- ★ Automatically armed 40 seconds after leaving vehicle.
- ★ 10 second entry delay with audible warning. (0.5 second available.)
- ★ Sounds horn or siren intermittently for 30 seconds - then re-arms.
- ★ Easy fitting - only 3 wires to connect - no holes to drill.
- ★ Controlled by ignition switch, hidden switch or coded remote control. (The optional siren and coded remote control are supplied separately.)

MICRO-PRESSURE ALARM Parts kit £15.95 Assembled £22.35
120dB PIEZO SIREN Assembled £11.95

VOLT DROP CAR ALARM

- ★ Volt drop sensing using existing courtesy light switches.
- ★ All the features of the Micro-pressure alarm except sensing system.

VOLT DROP CAR ALARM Parts kit £14.90 Assembled £20.95

NEW CODED IR REMOTE CONTROL

- ★ Adds remote control to our Micro-pressure or Volt Drop alarms.
- ★ High security, customer selected, 24 bit code, 59,046 combinations.
- ★ Anti-scanning system.
- ★ Key-ring transmitter with long life miniature alkaline battery.
- ★ High power infra-red emitter with range up to 5 metres.
- ★ Low profile dash top receiver/decoder.
- ★ Flashing high intensity red L.E.D. warns off intruders.
- ★ Green L.E.D. shows alarm is off.

CODE TRANSMITTER Parts kit £13.95 Assembled £17.95
CODE RECEIVER Parts kit £21.35 Assembled £26.55

MICRO-PRESSURE TRIGGER

- ★ Adds Micro-pressure sensing to any volt drop alarm system.

MICRO-PRESSURE TRIGGER Parts kit £10.95 Assembled £14.95

EXTENDED CDI ELECTRONIC IGNITION

- ★ Unique Total Energy Discharge system gives super power spark.
- ★ Adds electronic performance to contact breaker systems.

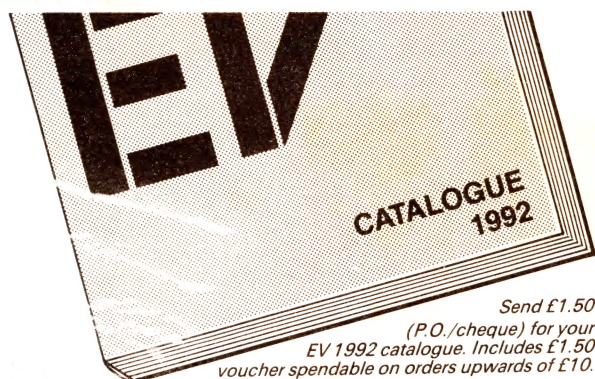
EXTENDED CDI IGNITION Parts kit £22.75 Assembled £28.45

All the above include cable, connectors and clear easy to follow instructions. All kits include case, PCB, everything down to the last washer, even solder. Prices are mail order discount, fully inclusive and apply to U.K. and Europe. Telephone orders accepted with VISA or ACCESS payment. Ask for detailed brochures or order direct (please quote ref. EE3) from :-

ELECTRONIZE DESIGN

Tel. 021 308 5877

2 Hillside Road, Four Oaks, Sutton Coldfield, B74 4DQ



Send £1.50
(P.O./cheque) for your
EV 1992 catalogue. Includes £1.50
voucher spendable on orders upwards of £10.

The CATALOGUE

120 pages, A4. Expertly presented and illustrated. Easily referred to. Packed with valuable information.

The COMPONENTS

As wide a choice as you could wish - semiconductors, surface mounting, opto-electronics, Rs & Cs, etc. Top quality; fairly priced.

The SUPPLIERS

Siemens, Boss, Cliff, Omeg, Lorlin, R.S., Uniross, etc. - to our top quality standards.

The SERVICE

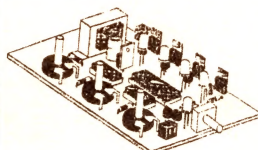
Prompt, personal, with customer satisfaction guaranteed. Access/Visa facilities.

Electrol/alue

28(A) St. Jude's Road, Englefield Green, Egham, Surrey TW20 0HB.
Phone - 0784 433603 Fax - 0784 435216

TK FOR KITS

DISCO SEQUENCER



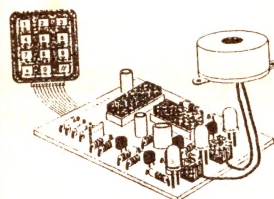
Four channels (up to 1kW each) to drive Rope lights, Pin-spots etc. (Resistive/inductive loads) with 30 different eye-catching sequences. Variable speed and sequence change frequency AND built in audio input. Ideal for mobile or permanent displays. Complete KIT (less box)

XXK141 26.95

Don't forget our other value for money DISCO KITS

DL8000	8-channel 80 programme sequencer	46.95
DL3000	3-channel sound to light	21.95
XXK124	High power strobe with audio input	17.95
XXK139	4-channel sequencer	14.50

PROGRAMMABLE ELECTRONIC LOCK

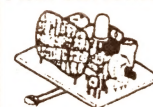


This kit should make keys obsolete. One 4-digit code entered on the keyboard could open the door to your shed, garage or home, or prevent unauthorised use of your computer, burglar alarm or car, while more than a preset number of incorrect entries will sound an alarm and disable the lock for a few minutes. If discovered, you can change the number easily from the keyboard. Supply: 5-15V d.c. Will drive our **Latch Mechanism (701 150 13.95)** or relay directly.

XXK131 22.50

SEND 50p & 9x6 SAE for our latest CATALOGUE which includes details on more exciting kits such as Remote Control, Touch Dimmers, Temperature Controller and COMPONENTS.

PROPORTIONAL TEMPERATURE CONTROLLER KIT



Uses 'burst fire' technique to maintain temperature within 0.5°C. Ideal for photography, incubators, wine making, etc. Maximum load 3kW (240V AC). Temperature range up to 60°C. Size 50 x 40 x 25mm

XXK140....£9.95

ORDERING INFORMATION: Prices INCLUDE VAT but please add £1.25 P&P (UK). Overseas Customers: divide total order by 1.175 then add P&P: Europe £3.50, elsewhere £10. Send PO/cheque/VISA/MASTERCARD No. with order. GIRO NO. 529314002. Local Authority and education orders welcome. Office Hours: Mon-Fri. 9.30 am - 5 pm. Shop Hours: Tues.-Thurs. 10 am - 5 pm Sat. 10 am - 1 pm.

ORDERS: 081 - 567 8910 24 HOURS

TK ELECTRONICS 13 BOSTON ROAD, LONDON, W7 3SJ.



ESR ELECTRONIC COMPONENTS

Station Road, Cullercoats,

Tyne & Wear NE30 4PQ

Tel. 091 251 4363

Fax. 091 252 2296

PCB EQUIPMENT

UV EXPOSURE UNIT - 229 x 159mm working area, built in timer, 2 x 8w tubes **£62.57**
PHOTO RESIST BOARD - single sided pre-sensitised FR4 glass fibre board. 3 x 4 in. **£0.86** 4 x 6 in. **£1.62** 6 x 6 in. **£2.41**
PLASTIC DEVELOPING TRAY **£1.35**
FERRIC CHLORIDE (0.5Kg) **£2.45**
TIN PLATING POWDER (90g) **£8.33**
STRIPBOARD 0.1 pitch 64 x 127mm **£1.30** 64 x 431mm **£4.03** 95 x 127mm **£1.52** 95 x 95mm **£1.33** 95 x 431mm **£5.27**
BREADBOARD 81 x 60mm 390TP **£2.98** 175 x 42mm 640TP **£3.40** 175 x 67mm 840TP **£5.34** *203 x 75mm 840TP **£7.00**
* inc plate & 4mm posts

KITS

Complete with screen printed & solder mask board, components and full instructions.
CAR ALARM voltage drop **£12.99**
200W CAR BOOSTER 12/24V CD/line/speaker input. inc housing. **£91.88**
ELECTRONIC DICE (dual) **£9.15**
SOUND GENERATOR 10 tones, line & speaker output **£19.11**
2.5W UNIVERSAL AMPLIFIER **£6.86**
AF SIGNAL INJECTOR/TRACER adjustable o/p & i/p **£8.39**
DIGITAL CODE LOCK 4 digit code flip/flop or latch o/p **£19.11**
AC MOTOR/DRILL CONTROLLER carbon brush 24-240Vac 5A **£15.28**

D CONNECTORS

Pin	Plug	Socket
9 pin	£0.29	£0.30
15 pin	£0.39	£0.39
15 Pin H.D.	£0.81	£0.90
23 pin	£0.40	£0.42
25 pin	£0.48	£0.50
9 Way plastic cover	£0.30	
15 Way plastic cover	£0.33	
23 Way plastic cover	£0.36	
25 Way plastic cover	£0.36	

CAPACITORS

Ceramic Disc 100V 10pF to 100nF **£0.07**
Ceramic Plate 100 & 63V 1.0pF to 12nF
1pF-1nF **£0.06** 1n2-2n7 **£0.09** 3n3-4n7 **£0.12** 10n & 12n **£0.06**
Polystyrene 160V 5% 47pF to 10nF
47p-2n2 **£0.09** 2n7-10n **£0.12**

SOLDERING IRONS

Antex Soldering irons **£7.11**
M 12 Watt **£7.11**
C 15Watt **£7.11**
G 18Watt **£7.30**
CS 17Watt **£7.21**
XS 25Watt **£7.30**
ST4 STAND **£2.75**
New PORTASOL HOBBY 35Watt gas iron **£11.17**
DESOLDER PUMP **£3.00**
ANTISTATIC PUMP **£4.30**
22SWG 0.5Kg Solder **£7.40**
18SWG 0.5Kg Solder **£6.60**
1mm 3 yds Solder **£0.50**

RESISTORS

Value	0.25W 5% CF E12 Series	0.5W 5% CF E12 Series	0.25W 1% MF E24 Series	POTS Log or Lin 470R - 1MO 25mm dia 0.25in shaft	PRESETS Enclosed Horz or Vert 100R - 1MO 0.1W	PRESETS Skeleton Horz or Vert 100R - 1MO 0.1W
0.25W 5% CF E12 Series	£0.60/100					
0.5W 5% CF E12 Series	£0.95/100					
0.25W 1% MF E24 Series	£1.72/100					
POTS Log or Lin 470R - 1MO 25mm dia 0.25in shaft	£0.40					
PRESETS Enclosed Horz or Vert 100R - 1MO 0.1W	£0.15					
PRESETS Skeleton Horz or Vert 100R - 1MO 0.1W	£0.11					

ELECTROLYTIC RADIAL CAPACITORS

uF	16V	25V	63V	100V
0.47	-	-	£0.05	£0.07
1.0	-	-	£0.05	£0.06
2.2	-	-	£0.05	£0.06
4.7	-	-	£0.05	£0.08
10	£0.05	£0.05	£0.06	£0.08
22	£0.05	£0.05	£0.09	-
47	£0.06	£0.06	£0.11	-
100	£0.06	£0.09	£0.11	-
220	£0.09	£0.12	£0.31	-
470	£0.15	£0.19	£0.57	-
1000	£0.22	£0.29	-	-
2200	£0.37	£0.57	-	-
4700	-	£1.11	-	-

HARDWARE

PCB Nylon Stand-offs clip into board, screw from base
5mm spacing **£0.24/10** **£1.68/100**
10mm spacing **£0.26/10** **£1.82/100**
13mm spacing **£0.30/10** **£2.10/100**
SELF TAPPING SCREWS Pan head
No 6 x 6.4mm **£0.14/10** **£0.88/100**
No 6 x 9.5mm **£0.12/10** **£0.78/100**
No 6 x 13mm **£0.13/10** **£0.85/100**
No 6 x 19mm **£0.16/10** **£1.04/100**
T2 Box 75 x 56 x 25mm **£0.76**
T3 Box 75 x 51 x 25mm **£0.72**
T4 Box 111 x 57 x 22mm **£0.92**
MB1 Box 79 x 61 x 40mm **£1.36**
MB2 Box 100 x 76 x 41mm **£1.48**
MB3 Box 118 x 98 x 45mm **£1.72**
MB5 Box 150 x 100 x 60mm **£2.36**

AUDIO CONNECTORS

PHONO PLUG inc strain relief, Red or Black **£0.17**
PHONO PLUG right angle, Red or Black **£0.23**
PHONO Chassis Socket **£0.16**
6.35mm Plastic Mono Plug with strain relief **£0.25**
As above but Stereo **£0.45**
6.35mm Chassis Socket, switched **£0.36**, switched Stereo **£0.49**
3.5mm Mono Plug **£0.17**
3.5mm Stereo Plug **£0.29**
3.5mm Mono line skt **£0.24**
3.5mm Stereo line skt **£0.29**
PLASTIC DIN PLUGS
2 pin **£0.15**, 5/360 **£0.27**, 3 pin **£0.24**, 6 pin **£0.30**, 4 pin **£0.29**, 7 pin **£0.33**, 5/180 **£0.26**, 8 pin **£0.45**, 5/240 **£0.30**
XLR Chassis Socket **£1.65**
XLR Chassis Plug **£1.32**
XLR Line Socket **£1.45**
XLR Line Plug **£1.36**

BRIDGE RECTIFIERS

Part	Price
W005 1.5A 50V	£0.19
W02 1.5A 200V	£0.20
BR32 3A 200V	£0.36
BR62 6A 200V	£0.64
1004 10A 400V	£1.39

74LS-Series

Part	Price
74LS00	£0.14
74LS01	£0.17
74LS02	£0.18
74LS03	£0.17
74LS04	£0.14
74LS05	£0.17
74LS08	£0.17
74LS09	£0.17
74LS10	£0.17
74LS11	£0.17
74LS12	£0.16
74LS20	£0.16
74LS21	£0.16
74LS26	£0.16
74LS30	£0.17
74LS32	£0.17
74LS37	£0.16
74LS42	£0.25
74LS51	£0.19
74LS86	£0.20
74LS92	£0.40
74LS93	£0.25
74LS107	£0.30
74LS109	£0.21
74LS123	£0.20
74LS125	£0.41
74LS133	£0.22
74LS138	£0.22
74LS153	£0.25
74LS154	£0.90
74LS157	£0.25
74LS164	£0.26
74LS165	£0.53
74LS175	£0.24
74LS191	£0.24
74LS193	£0.24
74LS367	£0.21
74LS374	£0.32

LINEAR ICs

Part	Price
TL071CP	£0.32
TL072CP	£0.34
TL074CN	£0.48
TL081	£0.29
TL082CP	£0.34
TL084CN	£0.46
TBA120S	£0.60
LM301A	£0.25
CA311E	£0.28
CA324	£0.23
LM348N	£0.31
LF351N	£0.36
LM358N	£0.27
LM377	£2.57
LM380N	£1.12
LM381	£2.70
LM386	£0.48
LM387	£1.60
LM392N	£0.79
LM393N	£0.28
CA555	£0.22
NE556N	£0.36
NE567N	£0.36
UA733	£0.18
CA741CE	£0.64
LM748CN	£0.31
TBA810S	£0.68
TBA820M	£0.39
LM1458	£0.26
ULN2004	£0.48
TDA2030	£1.35
CA3046	£0.37
CA3080	£0.72
CA3130	£0.98
CA3140	£0.44
CA3240	£1.22
LM3900	£0.72
LM3914	£2.70
LM3915	£2.70
MC4558	£0.36
NE5532	£0.80
ICL7621	£1.70

VELLEMAN KITS

Stockists of the full range of Velleman kits. Catalogue available upon request.

AUDIBLE WARNING

Frequency	Price
400Hz 75dB 9-20V	£0.72
450Hz 80dB 9-12V	£1.14
4KHz 90dB 3-15V	£0.92
2.8KHz 100dB pulsed	£1.60
3.5KHz 75dB 240Vac	£1.22
4KHz 80dB 30V pk-pk	£0.58

TEST & MEASUREMENT

HM103S ANALOGUE METER
19 ranges (inc 10Adc), fuse & diode protection, battery test, shock resistant tilted case, mirrored scale, supplied with battery, leads & instructions. Dim. 154 x 77 x 43mm **£11.47**
HC2020S ANALOGUE METER
20 Ranges (inc 10Adc), fuse & diode protection, transistor & diode tester, polarity reverse switch, high impact shock resistant case. Supplied with battery, leads, stand & instructions. Dim. 150 x 102 x 45mm **£18.45**
HYT07 LOGIC PROBE
TTL & CMOS, displayed in light & sound, pulse enlargement, pulse detection down to 25nsec, max freq. 20MHz. Supplied with full instructions. **£7.72**
MX190 DIGITAL METER
19 ranges, 3.5 digit 12mm LCD, signal injector, diode test, fuse protection, auto polarity & zero, supplied with battery, leads & instruction manual. Dim. 126 x 70 x 24mm **£14.73**
M2315B DIGITAL METER
33 Ranges (inc 20A ac/dc) PTC & fuse, diode test, buzzer, auto polarity & zero, over-range & low bat indication, supplied with battery, leads & instructions. Dim. 130 x 72 x 33mm **£23.40**
TL34 DIGITAL METER
33 Ranges (inc 20A ac/dc) PTC & fuse protection, 5 capacitance ranges, transistor test. 3.5 digit large 24mm display. Heavy duty case with tilt stand. Supplied with battery, leads & instructions. Dim. 191 x 88 x 36mm **£27.59**
HC213 ANALOGUE METER
12 ranges, diode protection, mirrored scale, 2mm leads. Pocket sized, supplied with battery & instructions. Dim. 90 x 60 x 30mm **£5.96**

SWITCHES

Miniature Toggle Switches
3amp 250v 6.4mm ϕ mounting **£0.58**
SPST Toggle **£0.54**
SPDT Toggle **£0.54**
SPDT CO Tog **£0.62**
PDPT Toggle **£0.68**
DPDT CO Toggle **£0.74**
DPDT CO Toggle (biased) **£1.20**
DPDT CO Toggle (biased 1 way) **£1.20**
DPDT mini slide **£0.15**
Rotary Wafer 1P-12V, 2P-6W, 3P-4W, 4P-3W **£0.78**
Key Switch SPST **£2.70**
Push to make **£0.25**
Push to break **£0.24**
Latching Push Sqr **£0.58**
PCB Tact 6 x 6mm **£0.25**

CONNECTORS

CROC CLIPS 33mm Red or Black **£0.12**
CROC CLIPS 45mm Red or Black **£0.20**
PP3 Battery Snap **£0.10**
PP9 Battery Snap **£0.14**
4mm BANANA PLUG Red or Black **£0.09**
4mm BUNCH PIN PLUG Red or Black **£0.30**
4mm BINDING POST Red or Black **£0.54**
SCART PLUG **£0.60**
SCART PCB Skt **£0.78**
SCART Line Skt **£1.35**
IEC LINE SOCKET **£0.78**
IEC CHASSIS PLUG **£0.72**
IEC CHASSIS Skt **£0.56**
CAR AERIAL PLUG **£0.19**
CIGAR LIGHTER PLUG **£0.30**

DIL SOCKETS

Pin	Price
8 Pin	£0.07
14 Pin	£0.11
16 Pin	£0.15
18 Pin	£0.15
20 Pin	£0.16
24 Pin	£0.19
28 Pin	£0.22
40 Pin	£0.25

4000 Series

Part	Price
4000	£0.20
4001	£0.17
4002	£0.19
4006	£0.32
4007	£0.20
4008	£0.31
4010	£0.19
4011	£0.16
4013	£0.17
4014	£0.30
4015	£0.31
4016	£0.18
4017	£0.25
4018	£0.27
4022	£0.32
4024	£0.21
4025	£0.15
4026	£0.40
4027	£0.18
4029	£0.27
4030	£0.17
4033	£0.56
4035	£0.31
4040	£0.29
4042	£0.22
4046	£0.31
4047	£0.25
4049	£0.25
4051	£0.25
4052	£0.25
4053	£0.24
4055	£0.31
4060	£0.31
4063	£0.29
4066	£0.18
4069	£0.20
4072	£0.17
4075	£0.17
4076	£0.30
4077	£0.15
4082	£0.17
4089	£0.55
4093	£0.15
4094	£0.31
4095	£0.56
4510	£0.26
4511	£0.29
4515	£0.78
4520	£0.26
4521	£0.84
4534	£2.48
4538	£0.37
4541	£0.31
4572	£0.25
4584	£0.24
4585	£0.48
41006	£0.24
40174	£0.34

MAGENTA

ELECTRONICS LTD



MAIL ORDER AND SHOP
EE11
135 Hunter S
Burton-on-Trent
Staffs, DE14 2S
Tel: 0283 6543
Fax: 0283 4693

VERSATILE BBC INTERFACE

A comprehensive interface which allows the BBC Model B computer to be connected safely to a wide range of input and output devices. Two leads connect the interface to the User port and Printer port. Up to 16 outputs (all via single pole change-over relay contacts) and 8 inputs. All inputs are fully protected. LED indication is provided on all lines. Requires an independent 12V supply
Full Kit Ref: 844 £51.95

STEPPING MOTOR DRIVER/INTERFACE

EE Jan '92

A single board, stand alone, stepping motor driver with built-in oscillator for variable low speed, high speed, and acceleration control. Suitable for all Magenta's four-phase unipolar motors and most others - up to 35V and 1.5A per phase. Half step, Full step and Wave-drive modes - switch selectable. LED mimic display and connector for computer port.
Kit includes MD35 motor

Kit Ref: 843 £29.95
Or Built £44.95

*Supplying Electronics
for Education,
Robotics, Music,
Computing and much,
much more*

**CATALOGUE
AVAILABLE PRICE
£1.00 INC. P&P**

All prices include VAT at 17.5%

Shop open 9-5 Mon.-Fri.

9-2 Saturday

Official orders welcome

Add £2

p&p to

all orders

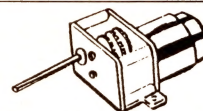
HAMEG HM 203-7 OSCILLOSCOPE

High quality reliable instrument made in W. Germany. Outstanding performance. Full two year parts and labour warranty. 20MHz-2 channels 1mV sensitivity. Easy to operate and high performance

(Cheques must be cleared) **£338 + £59.15 VAT**

Next day Delivery £10.00

D.C. MOTOR GEARBOXES



Ideal for Robots and Buggies. A miniature plastic reduction gearbox coupled with a 1.5-4.5 Volt mini motor. Variable gearbox reduction ratios are obtained by fitting from 1 to 6 gearwheels (supplied). Two types available:

Small Unit Type MGS £4.08

Speed range 3-2200 rpm. Size: 37 x 43 x 25mm

Large Unit Type MGL £4.65

Speed range 2-1150 rpm. Size: 57 x 43 x 29mm

STEPPING MOTORS

A range of top quality stepping motors suitable for driving a wide range of mechanisms under computer control using simple interfacing techniques.

ID36 Permanent Magnet Motor £16.86

48 steps per rev

MD200 Hybrid Motor £17.10

200 steps per rev

MD35 1/4 Permanent Magnet Motor £12.98

48 steps per rev.

MD38 Permanent Magnet Motor £9.15

48 steps per rev.

EVERYDAY ELECTRONICS KIT PROJECTS

ALL KITS HERE HAVE BEEN FEATURED IN EE AND ARE SUPPLIED WITH MAGAZINE ARTICLE REPRINTS. SEPARATE REPRINTS ALSO AVAILABLE PRICE 80p EACH INCLUSIVE P&P. KITS INCLUDE CASES, PCB'S, HARDWARE AND ALL COMPONENTS (UNLESS STATED OTHERWISE) CASES ARE NOT DRILLED OR LABELS SUPPLIED UNLESS STATED.

Ref	Price	Ref	Price
844	VERSATILE BBC INTERFACE Mar 92 £51.95	700	ACTIVE I/R BURGLAR ALARM Mar 87 £40.74
843	STEPPING MOTOR DRIVER/INTERFACE Jan 92 £29.95	584	SPECTRUM SPEECH SYNTH (no case) Feb 87 £23.90
	or built £44.95	581	VIDEO GUARD Feb 87 £9.59
842	PORTABLE ULTRASONIC PEST SCARER, Aug '91 £22.56	569	CAR ALARM Dec 86 £14.24
841	DIGITAL LCD THERMOSTAT May 91 £29.95	561	LIGHT RIDER LAPEL BADGE Oct 86 £11.65
	with punched and printed case	560	LIGHT RIDER DISCO VERSION Oct 86 £22.41
840	DIGITAL COMBINATION LOCK Mar 91 £19.86	559	LIGHT RIDER 16 LED VERSION Oct 86 £15.58
	with drilled case	556	INFRA-RED BEAM ALARM Sep 86 £32.39
839	ANALOGIC TEST PROBE Jan 91 £13.23	544	TILT ALARM July 86 £8.94
838	MICROCONTROLLER LIGHT SEQUENCER Dec 90. With drilled and labelled case £57.17	542	PERSONAL RADIO June 86 £13.17
835	SUPERHET BROADCAST RECEIVER Mar 90 With drilled panels and dial £17.16	528	PA AMPLIFIER May 86 £30.60
834	QUICK CAP TESTER Feb 90 £10.39	523	STEREO REVERB Apr 86 £30.21
833	EE 4 CHANNEL LIGHT CHASER Jan 90 £32.13	513	BBC MIDI INTERFACE Mar 86 £31.93
815	EE TREASURE HUNTER Aug 89 Full Kit £45.95	512	MAINS TESTER & FUSE FINDER Mar 86 £10.07
814	BAT DETECTOR June 89 £21.44	497	MUSICAL DOOR BELL Jan 86 £21.41
812	ULTRASONIC PET SCARER May 89 £14.81	493	DIGITAL CAPACITANCE METER Dec 85 £49.95
800	SPECTRUM EPROM PROGRAMMER Dec 88 £30.60	481	SOLDERING IRON CONTROLLER Oct 85 £6.25
796	SEASHELL SYNTHESIZER Nov 88 £28.55	464	STEPPER MOTOR INTERFACE FOR THE BBC COMPUTER less case Aug 85 £9.60
790	EPROM ERASER Oct 88 £28.51		1D35 STEPPER MOTOR EXTRA £9.15
769	VARIABLE 25V-2A BENCH POWER SUPPLY Feb 88 £56.82		OPTIONAL POWER SUPPLY PARTS £5.86
744	VIDEO CONTROLLER Oct 87 £33.29	461	CONTINUITY TESTER July 85 £7.08
740	ACOUSTIC PROBE Nov 87 £20.01	455	ELECTRONIC DOORBELL June 85 £8.63
739	ACCENTED BEAT METRONOME Nov 87 £23.94	444	INSULATION TESTER Apr 85 £22.37
734	AUTOMATIC PORCH LIGHT Oct 87 £19.62	392	BBC MICRO AUDIO STORAGE SCOPE INTERFACE Nov 84 £40.82
730	BURST-FIRE MAINS CONTROLLER Sep 87 £15.50	387	MAINS CABLE DETECTOR Oct 84 £6.31
728	PERSONAL STEREO AMP Sep 87 £16.34	386	DRILL SPEED CONTROLLER Oct 84 £9.91
724	SUPER SOUND ADAPTOR Aug 87 £43.86	362	VARICAP AM RADIO May 84 £15.02
722	FERMOSTAT July 87 £13.88	337	BIOLOGICAL AMPLIFIER Jan 84 £27.59
719	BUCCANEER I.B. METAL DETECTOR July 87 £30.22	263	BUZZ OFF Mar 83 £6.49
718	3-BAND 1.6-30MHz RADIO Aug 87 £30.30	242	INTERCOM no case July 82 £6.50
715	MINI DISCO LIGHTS June 87 £14.39	240	EGG TIMER June 82 £7.85
707	EQUALIZER (IONISER) May 87 £17.75	108	IN SITU TRANSISTOR TESTER June 78 £10.76
		106	WIERD SOUND EFFECTS GEN Mar 78 £8.94
		101	ELECTRONIC DICE Mar 77 £7.15

EDUCATIONAL BOOKS & BOOK PROJECTS

ADVENTURE WITH ELECTRONICS

The classic Easy to Follow book suitable for all ages. ideal for beginners. No soldering, uses an S-DEC breadboard. Gives clear instructions with lots of pictures. 16 projects - including three radios, siren, metronome, organ, intercom, timer, etc. Helps you learn about electronic components and how circuits work. Component pack includes an S-DEC breadboard and all the components for the series.

Adventures with Electronics £5.75
Component Pack (less book) £22.83

FUN WITH ELECTRONICS

From the USBORNE Pocket Scientist series - an enjoyable introduction to electronics. Full of very clear full colour pictures accompanied by easy to follow text. Ideal for all beginners - children and adults. Only basic tools are needed. 64 full colour pages cover all aspects - soldering - fault finding - components (identification and how they work). Also full details of how to build 6 projects - burglar alarm, radio, games, etc. Requires soldering - 4 pages clearly show you how. The components supplied in our pack allows all the projects to be built and kept. The book is available separately.

Fun with Electronics Book £2.95
Component pack (less book) £17.93

30 SOLDERLESS BREADBOARD PROJECTS

A book of projects by R. A. Penfold covering a wide range of interests. All projects are built on a Verobloc breadboard. Full layout drawings and component identification diagrams enable the projects to be built by beginners. Each circuit can be dismantled and rebuilt several times using the same components. The component pack allows all projects in the book to be built one at a time. Projects covered include amplifiers, light actuated switches, timers, metronome, touch switch, sound activated switch, moisture detector, MW Radio, Fuzz unit, etc.

30 Solderless Breadboard Projects (Book 1) £2.95
Component Pack £27.74

INSULATION TESTER

EE APRIL 85



A reliable electronic tester which checks insulation resistance of wiring appliances etc., at 500 volts. The unit is battery powered simple and safe to operate. Leakage resistance of up to 100 Megohms can be read easily. One of our own designs and extremely popular.

KIT REF 444

£22.37

3 BAND SHORT WAVE RADIO

EE AUG 87

Covers 1.6-30 MHz in 3 bands using modern miniature coils. Audio output is via a built-in loudspeaker. Advanced design gives excellent stability, sensitivity and selectivity. Simple to build.

KIT REF 718

£30.30

PORTABLE ULTRASONIC PEST SCARER

EE AUG '91

A powerful 23kHz Ultrasonic generator in a compact hand-held case. A MOSFET output drives a weatherproof transducer at up to 300V peak to peak via a special tuned transformer. Sweeping frequency output requires no setting up or alignment. Kit includes all components, PCB, transducer and case.

KIT REF 842

£22.56

EE EQUALISER

EE MAY '87

A mains powered loniser with an output of negative ions that give a refreshing feeling to the surrounding atmosphere. Negligible current consumption and all-insulated construction ensure that the unit is safe and economical in use. Easy to build on a simple PCB.

KIT REF 707

£17.75

LIGHT RIDERS

EE OCT '86

Three projects under one title - all simulations of the Knight Rider lights from the TV series. The three are a lapel badge using six LEDs, a larger LED unit with 16 LEDs and a mains version capable of driving six main lamps totalling over 500 watts.

KIT REF 559 CHASER LIGHT £15.58

KIT REF 560 DISCO LIGHTS £22.41

KIT REF 561 LAPEL BADGE £11.65

PET SCARER

EE MAY 89

Produces high power ultrasound pulses. L.E.D. flashes to indicate power output and level. Battery powered (9V-12V or via Mains Adaptor).

KIT REF 812

Mains Adaptor £2.02

£14.81

DIGITAL COMBINATION LOCK

EE MAR '91

Digital combination lock with a 12 key keypad. 4 digit code operates 250V-16A SPCO relay. A special anti-tamper circuit allows the relay to be mounted remotely from the keypad without any loss of security. Can be operated in many modes (latching/unlatching, manual/automatic setting, continuous/momentary output, etc.). Article describes operation as Vehicle Immobilising security system. Low current drain. Kit includes drilled case.

KIT REF 840

£19.86

ACOUSTIC PROBE

EE NOV '87

A very popular project which picks up vibrations by means of a contact probe and passes them on to a pair of headphones or an amplifier. Sounds from engines, watches and speech travelling through walls can be amplified and heard clearly. Useful for mechanics, instrument engineers and nosey parkers!

KIT REF 740

£20.01

MICROCONTROLLER LIGHT SEQUENCER

EE DEC '90

A superb kit with pre-drilled painted and silk screen printed case for a really professional finish. This kit uses a microcontroller I.C. to generate 8-channel light sequences. Sequences are selected by keypad from over 100 stored in memory. Space for 10 user programmed sequences up to 16 steps long also available. 1000 watts per channel, zero volt switching, inductive load capability. Opto-isolated for total safety. Many other features. Complete kit includes case, PCBs, all components and hardware.

KIT REF 838

£57.17

EE TREASURE HUNTER

EE AUG '89

A sensitive pulse induction Metal Detector. Picks up coins and rings etc., up to 20cms deep. Low "ground effect". Can be used with search-head underwater. Easy to use and build, kit includes search-head, handle, case, PCB and all parts as shown.

KIT REF 815

Including headphones

£45.95

DIGITAL LCD THERMOSTAT

EE MAY '91

A versatile thermostat with LCD read out. MIN/MAX temperature recording, clock and individually settable upper and lower switching points. Covers -10 to 110 degrees Celsius, accurate to within 0.1 degrees. Submersible probe on 3 meter lead. Kit includes punched and printed case. Save on energy bills by improved control of your hot water system. Also ideal for greenhouse soil temperature and aquarium control. Complete kit includes thermostat and probe, mains power supply and relay output, PCB's and punched and printed case.

KIT REF 841

£29.95

MOSFET VARIABLE BENCH 25V 2.5A POWER SUPPLY

EE FEB 88

A superb design giving 0.25V and 0-2.5A. Twin panel meters indicate Voltage and Current. Voltage is variable from zero to 25V. A Toroidal transformer MOSFET power output device, and Quad op-amp IC design give excellent performance.

KIT REF 769

£56.82

4 CHANNEL LIGHT CHASER

EE Jan '90

A 1000W per channel chaser with zero volt switching, hard drive, inductive load capability, mic sound sensor and sophisticated 'beat' detector. Chase steps to music or auto when quiet. Variable speed and mic. sens. LED mimic on front panel. Switchable for 3 or 4 channels. P552 output. Ideal for rope lights, pin spots, disco and display lighting.

KIT REF 833

£32.13

EPROM ERASER

EE OCT '88

Safe low-cost unit capable of erasing up to four EPROM's simultaneously in less than twenty minutes. Operates from a 12V supply. Safety interlock. Convenient and simple to build and use.

KIT REF 790

£28.51

SUPERHET BROADCAST RECEIVER

EE MAR '90

At last, an easy to build SUPERHET A.M. radio kit. Covers Long and medium Wave bands. built in loudspeaker with 1 watt output. Excellent sensitivity and selectivity provided by ceramic I.F. filter. Simple alignment and tuning without special equipment. Kit available less case, or with pre-cut and drilled transparent plastic panels and dial for a striking see-through effect.

KIT REF 835

£17.16

1992 CATALOGUE + 48 PAGE BARGAIN LIST - OUT NOW!

WINTER SUPPLEMENT OUT NOW!!

16 pages of goodies - security switches, lighting controllers, video mixers, enhancers, lights and tapes, ionizers, tools, relays + lots more!! Free with your order, or send large SAE.

DIGITAL THERMOSTAT

Z5228 Panel mntg unit (needs 60x27 cut-out). 2 digit display, set points, range -40 to +99°C. Has 8A c/o relay on board. Supplied with sensor and data **£14.95**

DUAL 7-SEG LED

Z2434 Red CA by TFK. 13mm digit. 2 for **£1.00**; 100+0.25; 1k+0.18

INSTRUMENT CASE

Z8969 426x290x78mm in light grey steel. Was an Isolan repeater. Contents have been removed - front panel has 4 LED's, back panel has fused suppressed IEC inlet, DP switch & 2X15W D sockets. **Only £9.95**

NICAD/LITHIUM OFFERS

Z2349 Nicad Battery Pack. Brand new, intended for use in Zonophones, comprising 4 x 1/2A size cells each rated 1.2V 0.45Ah, size 16.1mm dia x 28mm. DP £9.92.

Our price **£2.00** 100+ 1.00 1k+ 0.70

Z4150 Pack of 8 AA Nicads in tough plastic case 56 x 63 x 33mm.

Price **Only £1.60** 100+ 0.80

Z2450 AA Lithium 3.6V PC mntg.

Price **£2.00** 100+ 1.20

Z2451 1/2AA Lithium 3.6V PC mntg.

Price **£1.75** 100+ 1.05

HIGH VALUE CAPACITORS

Code	Value	Volts	Size	Price
Z4343	2200	40	45 x 26	60p
Z4419	3300	25	50 x 26	40p
Z5147	4700	100	105 x 51	£3.00
Z4345	10,000	40	56 x 41	£2.50
Z5146	10,000	100	105 x 64	£4.00
Z4346	15,000	25	56 x 41	£2.50

LOW COST SOUND CHIPS

UM34811A Melody generator.

Price **£1.20** 100+ 0.75

UM3562 3 gun sound generator.

Price **75p** 100+ 0.38

UM66 3 christmas carols **75p** 100+ 0.38

All supplied with a typical circuit.

BRIDGE RECT CLEARANCE

Z2347 4A 200V in line.

Prices **6/£1** 100+ 0.09 1k+0.06

PC KEYBOARDS

Z8946 Standard 102 key keyboard made by Cherry with Spin Din connector to plug straight into your PC! (switchable between MF/AT/XT) - Oh yes, nearly forgot - the keys have a Russian character set (in addition to English) so you can practice a bit of perestroika!

Price **Only £25.00**

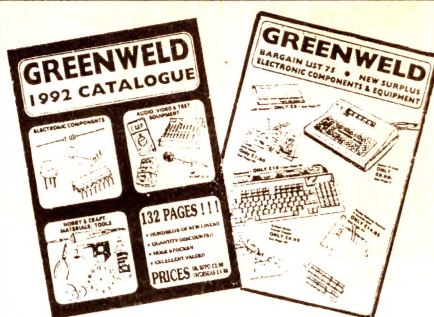
Z8954 AT/XT switchable, French character set. **£20.00**

Z8955 AT/XT switchable, German character set. **£20.00**

VARIABLE PSU KIT

K642 Simple kit utilising our Z660 power supply to give a 10 watt variable output from 4-20V, fully stabilised. Only needs 2 components added! Input must be at least 3V above max required output. Circuit features overload/short circuit protection and thermal cut-out. Input 7-25V DC, 1.5A; Output 4-20V DC variable 10 watts max; Size 50 x 50 x 21mm.

Price **£5.95**



132 Pages of Electronic, Hobby and Craft materials + Tools, Audio, Video and Test Equipment!! + 48 pages of Surplus Bargains! Only £2.00 inc post. Why not subscribe to the next 6 bargain lists at approx monthly intervals? Only £2 inc post.

VIEWDATA TERMINAL

Z8963 Tandata Modem as used with home banking system. Case 300 x 180 x 75/40mm with 75 key keyboard. Inside, UM1286 UHF modulator, Nicad, modem, lots of chips incl 2114 and 2732. Used but working **£12.95**

Z8964 Later model, brand new and boxed **£16.95**

OPTO BARGAINS

Z2171 24 character x 2 lines LCD by Optrex. High quality display with 192 character ROM, easily interfaced with either 4 or 8 bit uP's. Supplied with data. Characters are 5 x 7 dot arrays with separate cursor. Module size 118 x 35mm. DP around £30.00.

Our price **£10.00**

Z2172 40 character x 1 line LCD by Optrex (Japan). Double height display with 192 character ROM; other characters can be displayed by generation in RAM, easily interfaced with either 4 or 8 bit uP's. Supplied with data. Characters are 5 x 12 dot arrays measuring 3.2 x 10mm. Module size 220 x 40mm. DP over £50.00.

Our price **£15.00**

Z5096 16 character x 1 line. Very similar to our Z1814 but slightly larger character 6.3 x 3.15 (8 x 5 dots). Type LCDM16166 by Refac. Supplied with data. Uses Hitachi HD44780A00 chip (supplied). **£8.00**

Z4148 LCD as Z4115 but 6 digit, 50 pins. Trade price £10.86.

Price **£3.00**

Z5119 Communications LCD. This large (140 x 40mm) display (made for Marconi) has 110 pins and shows a variety of symbols and power levels used in radio communication, includes a bargraph display. No further info and only limited appeal, hence the very low price.

Price **Just £2.00**

Z4115 8 digit 12.7mm high LCD and holder. These are 14 segment devices allowing alphanumeric display. Normally costing over £15.00 we are offering these for just **£4.50**

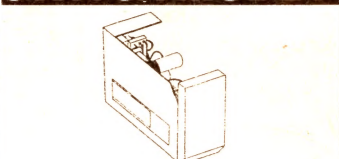
Z1637 LCD Display - direct drive 3 1/2 digit with 'Lo-Batt'. 12.7mm high digits. Op voltage 4-12 RMS @ 32Hz type. Consumes only 25µA with all segments on. Trade price £7.97 each. Supplied with data, but no edge connector.

Prices **£1.00** 25+ 0.65 100+ 0.50

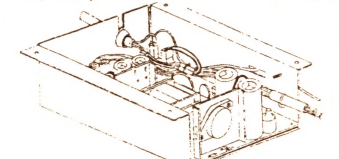
Z2163 4 Digit multiplexed LCD, 50 x 30mm probably for an electronic balance-symbols include balance pens, 5 stage bar graph, lb's and kg's etc. Digit height 12mm. Self adhesive pad on back. 13 pin PCB connector.

Price **£2.00**

SWITCH MODE POWER SUPPLIES



Z8921 Apricot PSU - beautiful unit 160 x 110 x 55mm with IEC switched mode inlet. Made by Astec. Model BM43024. 120/240V input. Outputs: +5V @ 2.5A; +12V @ 2A. **£12.95**



AA12351 Partially cased, overall size 160 x 104 x 45mm. Input and outputs are on flying leads, all colour coded. There is also an additional IEC socket to extend mains to another unit.

Input 115/230V, 50/60Hz

Outputs +5V 5A, +12V 0.15A

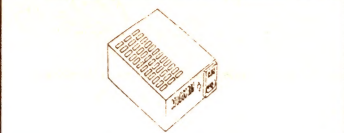
Total Wattage 50W

Price **£6.95** 25+ 5.43 100+ 4.53

Conversion Kit

K725 This kit converts the AA12531 PSU into a much more versatile supply, giving +5V @ 2.5A; +12V @ 2A; -12V @ 0.1A; -5V @ 0.55A. Complete kit of parts and full instructions.

Price **£3.50**



BM41012 Astec, totally enclosed steel cased unit 175 x 136 x 65mm, with switched and fused IEC mains inlet. PCB 160 x 80mm with output pins and connector.

Input 115/230V, 50/60Hz

Outputs +5V 3.75A, +12V 1.5A, 12V 0.4A

Total Wattage 65W

Price **£14.95** 25+ 11.70 100+ 9.75

Z8923 Intelligence SM060 80 watt unit 180 x 110 x 57mm. 120/240V input, and unusually 4 outputs: (Max rating per output quoted - total load must not exceed 80W): +5V @ 6A; +12V @ 2A; +25V @ 3A; -12V @ 500mA.

Price **£22.95**

All 1 off prices include VAT; quantity prices do not. P & P £2.50 per order. Min Credit Card £12. Official orders from Education welcome; min invoice charge £15.00.

Payment is accepted by cheque, postal order, cash (including foreign currency bank notes) book tokens, Access, Visa, Connect.

Our stores have enormous stocks of components and our trade counter is open from 9-5.30 Mon-Sat. Come and see us!

Tel: (0703) 236363 Fax: (0703) 236307

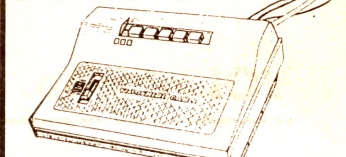


27D PARK ROAD, SOUTHAMPTON, SO1 3TB

TIMER SWITCH

Z5174 Superb geared mains motor 1 rev per 12 hrs with cam operated switches - 2 c/o rated 16A 250V. Size 60 x 54 x 43mm. **Only £3.00** 100+ 1.50

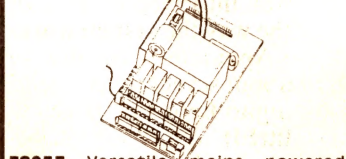
CABLE TV UNIT



Z8939 Two tone brown case contains PCB 192 x 195mm with easily removed UHF modulator made by Labgear (Sound and Vision); video pre-amp; stabilised power supply and all the decoding circuitry (9 transistors and TBA673 chip). On the front of the case is a cable/off air switch and 5 push buttons (5 channels and on/off mains switch). There are 4 cables coming from the rear. The case can easily be utilised for other purposes - the dark brown inserts on the front are both easily removable, if required. Please note the low price we are asking in no way reflects their true worth - they're taking up a lot of space, so we need to shift them quickly!! Supplied with circuit diagram.

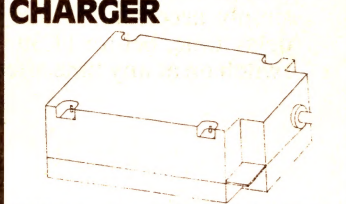
Price **£6.95** 100+ 3.50 1k+ 2.50

COMPUTER INTERFACE



Z8957 Versatile mains powered switching unit and power supply, ideal for controlling up to 5 separate circuits via BBC user port. Supplied with 6 program listings and full instructions. Can also be used with PC - details included. Relay contacts are SPCO rated 10A. There's also 2 auxiliary DC outputs, 12V @ 1.5A and 5V @ 1A. **£14.95**

HIGH QUALITY NICAD CHARGER



Z5136 Nicad switched mode battery charger for charging 6 x AA, C or D cells. 70mA 16 hour rate, 700mA 1.5 hour rate, 25mA float charge automatically switched in when battery reaches correct charge level. Outputs for fast and slow charging simultaneously if necessary, both on timers to prevent over charging. **£12.95**

STEPPER MOTOR

Z5054 Superb little 12V motor by Airpax. 35mm dia x 21mm deep with a 16 tooth 9.5mm dia gear wheel mounted on the 2mm dia spindle. Fixing centres 42mm 7/8", 48 step. 100+ price is £9.04. Supplied with data sheet.

Prices **£3 each** 100+ 2.00

EASIWIRE

The easy to use no-soldering wiring tool which makes construction of small electronic projects so simple! All included in the kit are: Wiring pen; Utility tool; Punched wiring board; Self adhesive sheet; Spring loaded terminals and jacks; Spare spool of wire; Excellent instruction book. Catalogue price £15.00.

Price **£5.00**

EVERYDAY ELECTRONICS

INCORPORATING ELECTRONICS MONTHLY

Editorial Offices:

EVERYDAY ELECTRONICS EDITORIAL,
6 CHURCH STREET, WIMBORNE,
DORSET BH21 1JH

Phone: Wimborne (0202) 881749

Fax: (0202) 841692. DX: Wimborne 45314.

See notes on **Readers' Enquiries** below – we regret that lengthy technical enquiries cannot be answered over the telephone.

Advertisement Offices:

EVERYDAY ELECTRONICS ADVERTISEMENTS,
HOLLAND WOOD HOUSE, CHURCH LANE,
GREAT HOLLAND, ESSEX CO13 0JS.

Phone/Fax: (0255) 850596

VOL. 21 No. 3

MARCH '92

SEASONAL CHANGE

A bit of a strange mixture this month, with a *Get You Through Winter Special* and a Free Spring Catalogue. Of course it is the March issue which "comes in like a lion and goes out like a lamb", but then we publish it at the beginning of February – it's all done just to confuse everyone!

Anyway even if there is not much winter left by the time you read this, all the projects can be built, tested and ready for the next one! Having said that I bet we will be knee deep in snow and/or freezing cold well into March: You just can't tell these days!

ECONOMY

When we did some research into Economy Seven electricity to check the validity of the timer in this issue I was surprised to find that no timers are used for heating circuits these days, the whole house simply goes on to a cheap rate after 11.30 p.m. (12.30 in Summer Time). Perhaps I am not too well informed on this, or maybe the electricity boards have not publicised the way the system works (the times may vary in different regions).

Apparently, because of the different charging structure you need to use about seventeen per cent or more of your electricity at night to make changing to Economy Seven worthwhile (it costs nothing to have the new meter fitted). What this means is that if you are using Economy Seven then it is obviously worthwhile using as many of your appliances at night as possible.

Our timer will give you the chance to switch on washing machines, tumble driers, dishwashers, etc. after you have gone to bed without any hassle. I suppose with automatic cookers it would also be possible to bake while you are asleep if you really want to save every penny!

If you do not use electricity for any form of heating it might still be worthwhile checking how much power you could use at night to see if a change might be worthwhile. With a pre-set timer on each appliance it is simply necessary to turn on the appliance at any time within the preset delay time, before 11.30 p.m. i.e. with a pre-set delay of two hours simply switch on at any time after 9.30 p.m. (10.30 p.m. during Summer Time).

Mike Kenward

SUBSCRIPTIONS

Annual subscriptions for delivery direct to any address in the UK: £18.50. Overseas: £23 (£40.50 airmail). Cheques or bank drafts (in £ sterling only) payable to Everyday Electronics and sent to EE Subscriptions Dept., 6 Church Street, Wimborne, Dorset BH21 1JH. Tel: 0202 881749. Subscriptions start with the next

available issue. We accept Access (MasterCard) or Visa payments, minimum credit card order £5.

BACK ISSUES

Certain back issues of EVERYDAY ELECTRONICS are available price £1.80 (£2.30 overseas surface mail) inclusive of postage and packing per copy – £ sterling only please, Visa and Access (MasterCard) accepted, minimum credit card order £5. Enquiries with remittance, made payable to Everyday Electronics, should be sent to Post Sales Department, Everyday Electronics, 6 Church Street, Wimborne, Dorset BH21 1JH Tel: 0202 881749. In the event of non-availability one article can be photostatted for the same price. *Normally sent within seven days but please allow 28 days for delivery. We have sold out of Jan, Feb, Mar, Apr, June, Oct, & Dec. 88, Mar & May 89 & Mar 90.*

BINDERS

Binders to hold one volume (12 issues) are available from the above address for £5.95 (£6.95 to European countries and £8.00 to other countries, surface mail) inclusive of post and packing. *Normally sent within seven days but please allow 28 days for delivery.*

Payment in £ sterling only please. Visa and Access (MasterCard) accepted, minimum credit card order £5. Tel: 0202 881749

Editor: MIKE KENWARD

Secretary: PAMELA BROWN

Deputy Editor: DAVID BARRINGTON

Business Manager: DAVID J. LEAVER

Editorial: WIMBORNE (0202) 881749

Advertisement Manager:

PETER J. MEW, Frinton (0255) 850596

Classified Advertisements:

Wimborne (0202) 881749

READERS' ENQUIRIES

We are unable to offer any advice on the use, purchase, repair or modification of commercial equipment or the incorporation or modification of designs published in the magazine. We regret that we cannot provide data or answer queries on articles or projects that are more than five years old. Letters requiring a personal reply must be accompanied by a **stamped self-addressed envelope** or a **self addressed envelope and international reply coupons**.

All reasonable precautions are taken to ensure that the advice and data given to readers is reliable. We cannot however guarantee it and we cannot accept legal responsibility for it.

COMPONENT SUPPLIES

We do not supply electronic components or kits for building the projects featured, these can be supplied by advertisers.

We advise readers to check that all parts are still available before commencing any project in a back-dated issue.

We regret that **we cannot provide data or answer queries on projects that are more than five years old.**

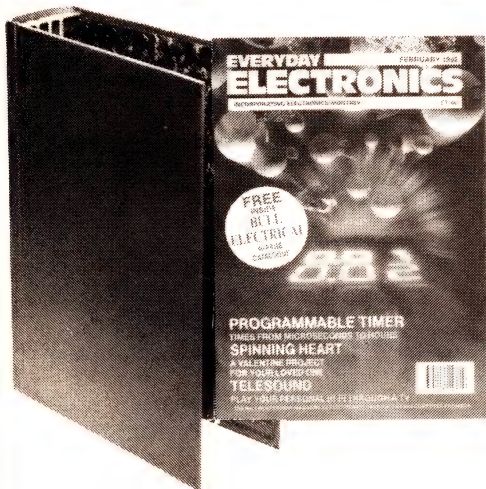
ADVERTISEMENTS

Although the proprietors and staff of EVERYDAY ELECTRONICS take reasonable precautions to protect the interests of readers by ensuring as far as practicable that advertisements are *bona fide*, the magazine and its Publishers cannot give any undertakings in respect of statements or claims made by advertisers, whether these advertisements are printed as part of the magazine, or are in the form of inserts.

The Publishers regret that under no circumstances will the magazine accept liability for non-receipt of goods ordered, or for late delivery, or for faults in manufacture. Legal remedies are available in respect of some of these circumstances, and readers who have complaints should first address them to the advertiser.

TRANSMITTERS/BUGS/TELEPHONE EQUIPMENT

We would like to advise readers that certain items of radio transmitting and telephone equipment which may be advertised in our pages cannot be legally used in the U.K. Readers should check the law before using any transmitting or telephone equipment as a fine, confiscation of equipment and/or imprisonment can result from illegal use. The laws vary from country to country; overseas readers should check local laws.



EMERGENCY LIGHTPLUG

IVOR SADLER

An emergency light which comes on automatically in case of mains failure, it also doubles as a rechargeable hand lamp.

THE pluglight operates in much the same manner as the emergency lights which are mandatory in public places, coming on automatically in the event of a power failure. It has the advantage over such emergency lights of being portable so it will double as a hand lamp if required.

In the normal standby mode the internal batteries are charged continuously at 25 milliamps. In the event of a power failure or when used as a hand lamp the internal batteries will last for half an hour. To double this time you could if preferred fit one bulb only.

CIRCUIT DESCRIPTION

From Fig. 1 it can be seen that a full wave rectifier provides the power source,



and the batteries are charged through R1. An l.e.d. (D5) indicates that charging is in progress and the current for it is taken through the bulbs to provide continuous confirmation that they are in working order. A positive voltage is applied through

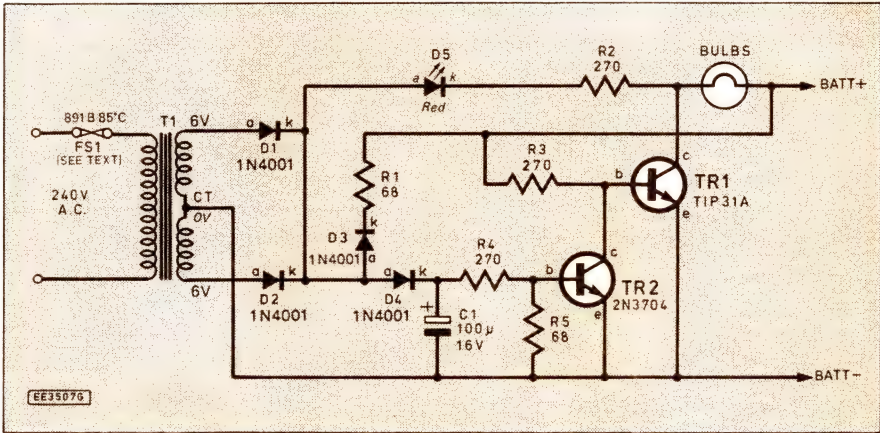


Fig. 1. Circuit diagram of the Emergency Pluglight.

diode D4 to the base of transistor TR2 keeping it turned on, thus grounding the base of transistor TR1 which is consequently held off.

If the supply to the transformer is broken the base bias to transistor TR2 is removed causing it to turn off thus allowing the voltage on the base of transistor TR1 to rise which then turns hard on allowing the current from the battery to flow through the bulb. As soon as the power supply is restored the circuit reverts to the charging state.

Perhaps the type of transformer chosen deserves some justification as it is a 6-0-6 volt 250mA type which on the face of it seems on the generous side to supply approximately 30 milliamps all told. One reason for this is that transformers tend to run warm even with no load and, as the transformer in this device will be running continuously in a confined space, it is as well for it to be lightly loaded to minimise heat output. Another reason is that a physically smaller transformer would present mounting problems.

CONSTRUCTION

The project can be conveniently housed in a larger "PSU Box and Plug" provided that the two sections of the box are held together by screws not glue, as it will be necessary to open the box every few years to replace the batteries.

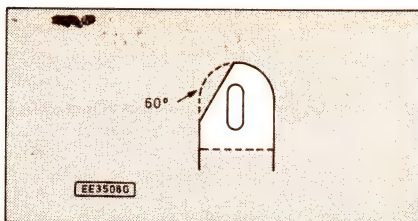


Fig. 2. Modification of the transformer mounting.

Included with the box is an internal moulding to hold the mains pins in place and to isolate the mains input from the low voltage circuitry. All the projecting pieces will have to be removed from the top side of this moulding leaving a flat plate on which the transformer will be mounted, but since the transformer will be screwed or bolted through this plate to the bottom of the box, the plate will serve both purposes for which the internal moulding was designed. Incidentally it is better not to push the mains pins into place until all the mechanical work has been completed on the box.

MAINS TRANSFORMER

The screws to fix the transformer need to be approximately 50mm apart to straddle the recess in the plug box where the mains pins are located and this must be borne in mind when choosing the transformer. The mounting slots can usually be extended outwards and those on the prototype were, by about 2mm, using a small round file. The transformer will have to be mounted as close as it will go to the left hand side of the box and as near as possible to what will be the top of the box when it is plugged into a socket. Any subsequent reference to the "top" will have the same meaning and left and right will be relative to it.

The primary wires are best positioned on the left hand side of the transformer from where they can be led round the left hand

pillar and in due course under the platform to where the mains pins will fit. Locating the transformer will be facilitated by positioning the battery box with the batteries in it along the right hand side of the box using a little Blue Tack or something similar to hold it in place.

Cut or file a corner off the top foot of the transformer at an angle of 60 degrees without breaking into the mounting slot (Fig. 2) to allow the foot to clear the left hand pillar. Hold the transformer firmly in place with the bobbins as close as possible to the left hand side of the box and drill the holes for the screws or bolts as far apart as the mounting slots will allow, it is advisable to put a small pilot drill through first to make sure that you are completely clear of the well, and screw the transformer in place for now.

The holes for the lampholders can now be drilled in the bottom of the upper section, these are 11mm in diameter and their suggested positions are shown in Fig. 3 but this is very much a matter of choice. Fix the lampholders in place with any suitable adhesive around the flange and front of the holder. Wire them in parallel with two

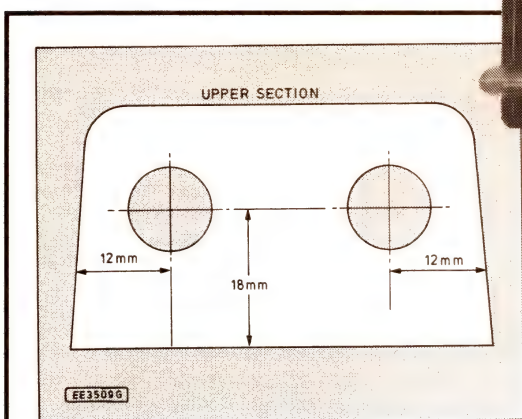
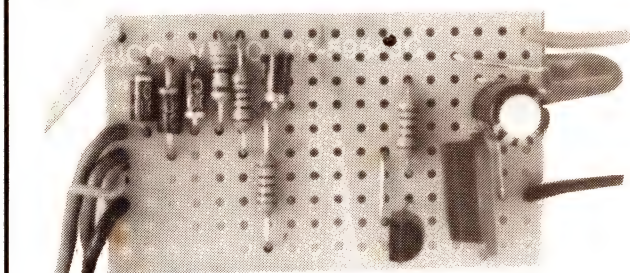


Fig. 3. Hole positions for the twin lamps. The lamps are wired in parallel.



COMPONENTS

Resistors
R1, R5 68 (2 off)
R2 to R4 270 (3 off)
All 1/4 watt metal film

Capacitor
C1 100µ elect. 16V

Semiconductors
D1 to D4 1N4001 (4 off)
D5 5mm l.e.d. 2mA
TR1 TIP31A npn transistor
TR2 2N3704 npn transistor

Miscellaneous
FS1 Thermal fuse 891B 85°C
T1 Mains transformer miniature 250mA 6.0-6V

Batteries, Nicad type AA (2 off); battery holder 2 x AA; stripboard, 24 holes by 10 strips; battery connector PP3; bulb(s) MES lens bulb 2.2 volt (2 off - see text); lampholders, MES clip-on holder; P.S.U. box with plug; connecting wire; fixings etc.

**See
SHOP
TALK
Page**

**Approx cost
guidance only**

£12

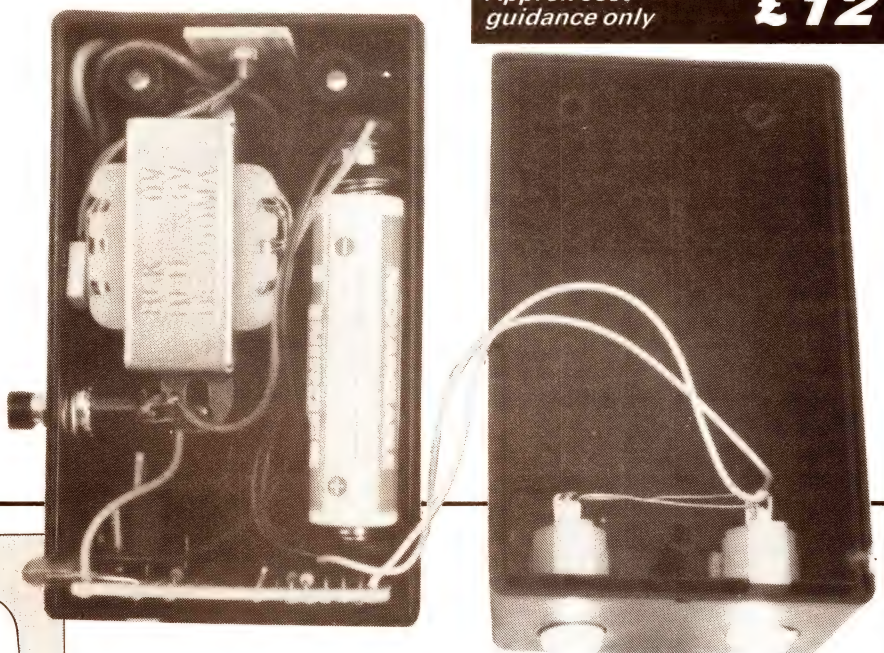
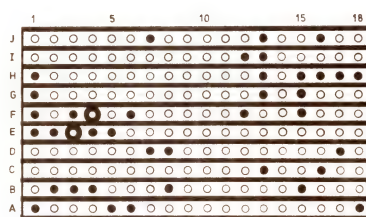
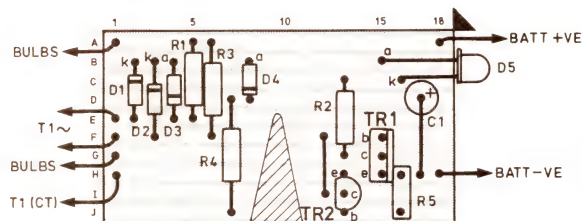


Fig. 4. Stripboard layout and wiring.



EE3510G

short leads (about 10cm) for connecting to the strip board.

The two halves of the box should now be screwed together temporarily and, gripping them tightly, a 5mm hole should be drilled through the joint in the box 6mm from the bottom left hand corner this is for D5. A clamp would be useful but gripping by hand should be satisfactory, using a 1mm drill as a pilot.

STRIPBOARD

The piece of stripboard 10 strips by 24 holes should be cut into two pieces one with eighteen holes and the other with six, this smaller piece will be required later for the transformer primary circuit. Taking the large piece first, track breaks are required on track E hole 3 and track F hole 4.

From the layout diagram Fig. 4 it can be seen that the centre holes of the board are not used, this is because this part of the board, with some slight adjustment, fits behind the bottom centre pillar. This provides the main support for the board.

The adjustment which should be made before fixing any components consists of a small hollow in the lower part of the top face of the board between holes 9 and 10 (the shaded area in the layout diagram Fig. 4). This can be made with a small half round file checking from time to time that it fits neatly behind the pillar. Make sure you do not file too much of the board away, it is essential that the copper strips remain unbroken and well supported.

Wiring the components should present no problems provided surplus leads are cropped close to the board. TR1 should be inserted with only the broader part of its pins protruding above the board and the l.e.d., D5 should be mounted with the bottom of the bulb flush with the edge of the board thus when the box is assembled the l.e.d. will just protrude through the side and this, together with the support provided by the pillar, will hold the board in place quite securely.

TESTING

Having connected the PP3 battery clip, the lampholders and the three connections from the secondary of the mains transformer the circuit can be tested by fitting the batteries and bulbs and connecting the transformer to the mains using two segments of strip connector wired to a three pin plug. Switch on the power and the l.e.d. should light up at more or less full brilliance.

If you have a milliammeter check that the current flowing to the batteries is about 30mA, disconnect the milliammeter otherwise the meter will be subjected to a heavy reverse overload, and reconnect the batteries before switching the mains supply off, when the bulbs should light up. The unit could be left running for a while at this stage to make sure there is no overheating and, if the batteries are new and uncharged, it would be as well to do this before testing that the bulbs do light up.

If you do not have a milliammeter a voltmeter connected across R1 should read about 2.2 volts, this represents a current slightly higher than the charging current because of the small unavoidable current drain via R3.

MAINS CONNECTION

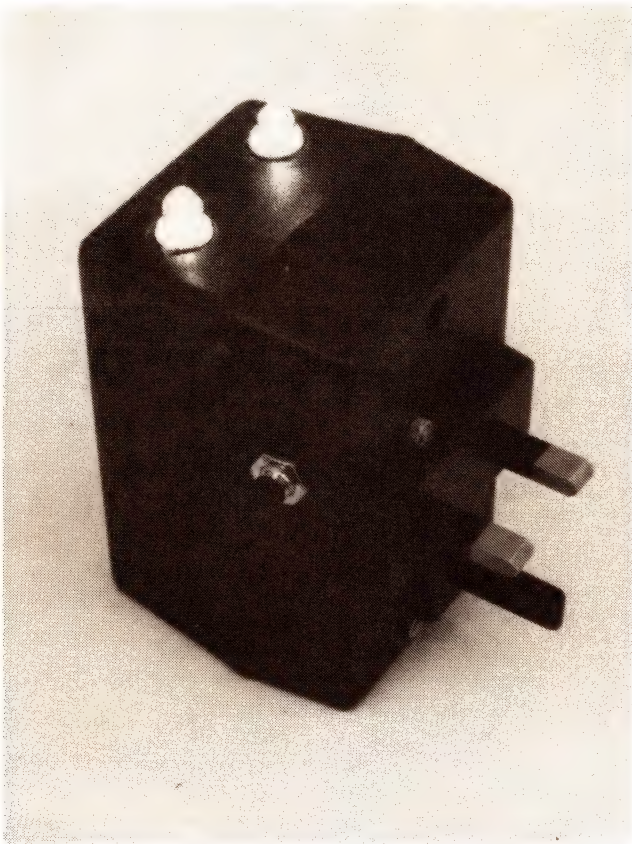
Turning now to the mains primary circuit, disconnect the unit from the mains and prepare to mount the small piece of stripboard at the top of the plug box by drilling a hole in the centre 4mm down from the outer edge of the lower section to take an 8BA or similar screw. Drill a corresponding hole in the board between strips 4 and 5 then cut the brown wire at a convenient point and solder the length from the transformer to the left hand hole in the second strip up and the other length to the right hand hole in the next but one strip higher.

Slide pieces of insulating sleeve on the leads of the thermal fuse and connect it between the two strips taking care **not to overheat the fuse and thus destroy it** (tinning round the holes to be used will speed up the jointing and holding the wires in position with a heat shunt helps, if you don't possess one a ladies pin curl clip will do nicely!) then screw the board in place **using only a nylon screw and nut.**

Connecting the primary wires to the mains pins is best done with the pins not in place as it is all too easy to touch the sides of the box with a hot iron which can be disastrous. Remove the transformer, battery box and circuit board etc and solder the transformer primary wires to the mains pins, noting the angle they should make with the pins to marry up with the under side of the moulding designed to hold the pins in place. One way of doing this is to solder a 6BA solder tag to each pin set at the correct angle then solder the wires to the tags.

Finally push the three mains pins into their holes, slide the internal moulding into place leading the wires under it and screw the transformer down firmly. The ceramic body of the thermal fuse can now be tucked between the primary winding and the side of the box. Assemble the other units in the plugbox and screw the two sections together to complete the project.

According to the use you might make of the device, for example if you are likely to want to make use of it frequently as a hand lamp, there is ample room to fit a momentary push off switch on the left hand side of the box (see photos) between the transformer and the stripboard, making sure you clear TR1, the tallest component. Clearly it must be a momentary action switch otherwise there would be a danger of negating the main purpose of the device. This switch should be wired in the lead from A18 to battery positive. □



WINTER 1991/1992 CATALOGUE

OUT NOW!

- 100's of price reductions throughout the catalogue
- 200 pages
- Latest new products
- £££'s worth of discount vouchers
- On sale from 14th November at most large newsagents or directly from **Cirkit**



Cirkit

£1.70
plus 30p postage



CIRKIT DISTRIBUTION LTD

Park Lane · Broxbourne · Hertfordshire · EN10 7NQ

Telephone (0992) 444111 · Fax (0992) 464457

PCB & SCHEMATIC CAD	DIGITAL SIMULATION	ANALOGUE SIMULATION	SMITH CHART CAD
EASY-PC £98	PULSAR £195	ANALYSER III £195	Z-MATCH II £195
• Design Single sided, Double sided and Multilayer boards. • One software package for Schematics and PCB's. • Standard output includes Dot Matrix / Laser / Inkjet printers, Pen Plotters, Photo-plotters and NC Drill. • Award Winning EASY-PC is in use in over 11,000 installations in 70 Countries World-Wide. • Runs on PC/XT/AT/286/386 with Herc, CGA, EGA, VGA. • Optional libraries include SM Components etc.etc	• At last! A full featured Digital Circuit Simulator for less than £1000! • Pulsar allows you to test your logic designs without the need for expensive test equipment. • Catch glitches down to a pico second per week! • Includes 4000 Series CMOS and 74LS Libraries. • Runs on PC/XT/AT/286/386/486 with EGA or VGA. Hard disk recommended. • 74HC / HCT Libraries optional at £48.00 each.	• NEW powerful ANALYSER III has full graphical output. • Handles R's,L's,C's, Bipolar transistors, FET's, Op-Amp's, Tapped and Untapped Transformers, and Microstrip and Co-axial Transmission Lines. • Plots Input and Output Impedances, Gain, Phase and Group Delay. • Covers 0.001 Hz to >10GHz • Runs on PC/XT/AT/286/386/486 with EGA or VGA displays. • Very fast computation.	• Z-MATCH II takes the drudgery out of RF matching problems and includes many more features than the standard Smith Chart. • Provides quick accurate solutions to many matching problems using transmission line transformers, stubs, discrete components etc.etc.. • Supplied with comprehensive user instructions including many worked examples. • Runs on PC/XT/AT/386/486, CGA,EGA,VGA. • Ideal for both education and industry.

For full info' Phone, Fax or Write to:

Number One Systems Ltd.
The Electronics CAD Specialists



Technical support free for life! Programs not copy protected

REF: EVD, HARDING WAY, SOMERSHAM ROAD, ST.IVES, HUNTINGDON, CAMBS, PE17 4WR, ENGLAND.
Telephone: 0480 61778 (7 lines) Fax: 0480 494042 International: +44-480-61778 Fax: +44-480-494042

ACCESS, AMEX, MASTERCARD, VISA Welcome.

ECONOMY SEVEN TIMER

CHRIS BROWN

Allows you to use more appliances at night - dishwasher or washing machine - and save you money!

GENERATING electricity is a 24-hour a day business. Obviously, during the day and evening, most of the power is consumed by you and I, but during the night, when demand drops, surplus electricity is wasted, burnt off as heat by the miles of cable en route.

To help reduce this wasteful practise, the electricity companies introduced a special reduced night-rate tariff known as "Economy Seven". Storage heaters use this energy to warm up special radiators, which then release this heat during the day. So if you're using this tariff, why not save even more pennies by using other electrical appliances during this cheaper rate period?

The problem is that the cheaper rate only comes into effect after 11.30 p.m. (12.30 a.m. in summer). **Note:** This time may vary in different regions. Most people will not want to sit up just to turn on the washing machine/dishwasher once the rate has started. So this simple timer was devised. The timer is marginally cheaper to build than the usual mechanical type time switch.

CIRCUIT

Basically the circuit, Fig. 1, consists of an hour timer, a counter, and a switch (plus a little something to make calibration easier). Since the unit uses a low voltage transformer, it will only add an n'th of a

penny to your fuel bill each time it is used.

The 4060, IC1 (Fig. 1) is an oscillator and 14 stage divider all on one chip, arranged here so that the 13th stage goes high after one hour. This output pulse resets the 4060 to initiate another timing period, and at the same time clocks IC2, a 4017. To achieve this, the components on pins 9 to 11 of IC1 have to be set to produce a timing period of 0.8789062 secs! It would not be easy to set that with any degree of accuracy.

Fortunately, at that speed, the 4th stage changes state every seven seconds and this causes D4 to flash, via C3 every 14 seconds. Thus, if the unit is calibrated so that the l.e.d. flashes once every 14 seconds, we have the correct timing period. Even if one was very lax in setting this time, an error of ± 1 second would only mean a difference of plus or minus eight minutes per hour - and a one second error is a large discrepancy!

Once an hour then, IC1 clocks IC2, a ten stage counter. At switch on, stage 0 (pin 3), is high. The counter is reset by C5 and R5 at switch on. After one hour stage 1 (pin 2), goes high. Thus when you are considering the delay time, it is best to think of each stage as "hours elapsed", i.e. stage 1 is one hour, stage 2 is two hours, etc.

DELAY TIME

In the prototype, a two hour delay was

required, and a two hour run time. Stages 0 and 1 were left open, and stages 2 and 3 connected to the base of TR1 via two diodes. When the latter stages go high, they supply base drive, and thus turn on the relay, which in turn switches on the external appliance.

Depending on which outputs are left open, and which are wired to TR1 the user can set his own desired delay/run time settings. For instance if a three hour delay and a four hour run time is required wire stages 3 to 6 to TR1 using four diodes.

A few extra items help the circuit along. R1, Zener D3 and C1 smooth the a.c. supplied by the transformer, providing approximately 15 volts to the circuit. Diode D5 avoids any back e.m.f. damaging TR1 when the relay switches off, whilst resistors R4 and R5 hold IC2's inhibit and reset pins low during run time.

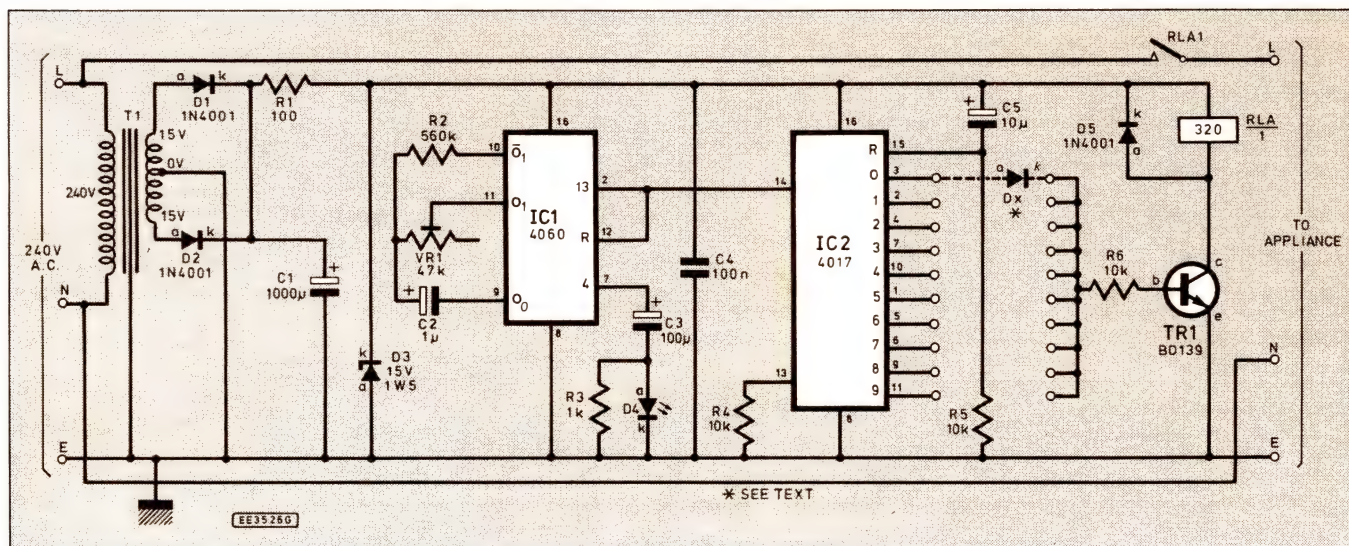
CONSTRUCTION

Construction should present few problems. The p.c.b. component layout is shown in Fig. 2.

Note: VR1 is glued to the case lid, which has a hole in to access the core. This is a safety feature; you can screw the lid onto the case and ensure those "nasty" 240 volt mains connections cannot be accidentally touched, but still be able to adjust the flash rate of D1.

The unit must be housed in an Earthed metal case or **fully insulated** plastic case. If using plastic make sure that the screws/fixings used for mounting the p.c.b. and the transformer are nylon; no metal

Fig. 1. Complete circuit diagram for the Economy Seven Timer.



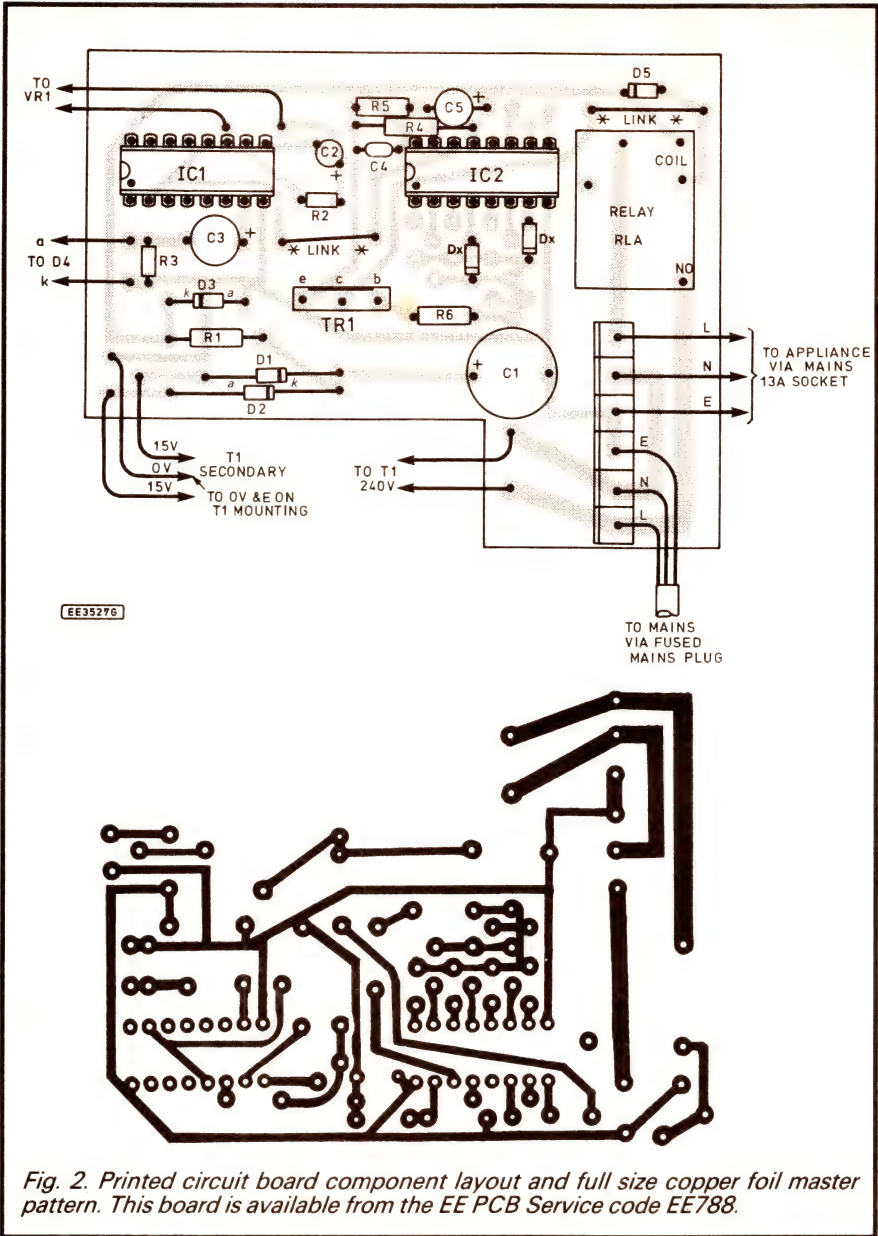
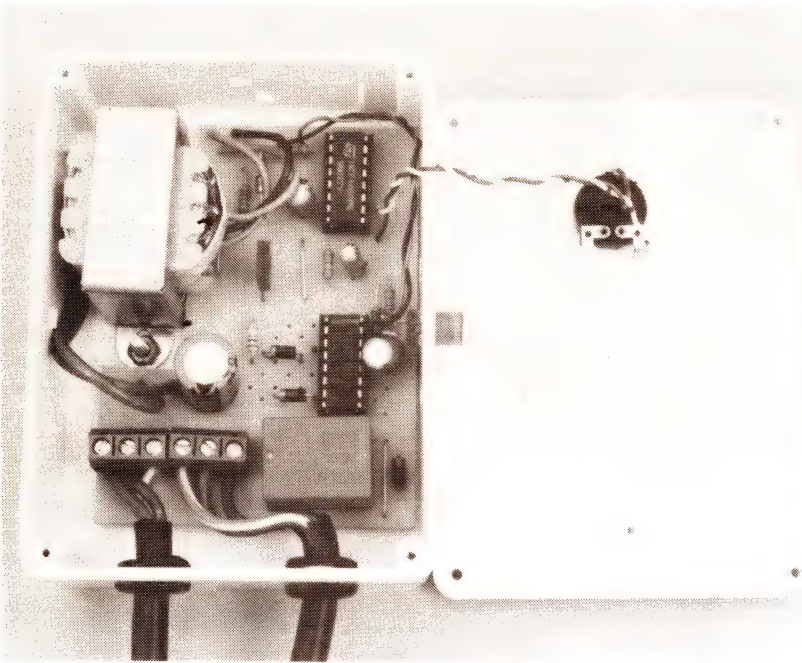


Fig. 2. Printed circuit board component layout and full size copper foil master pattern. This board is available from the EE PCB Service code EE788.

Layout of components inside the completed unit. The timing control VR1 is glued over a small hole drilled in the case lid.



COMPONENTS

Resistors

- R1 100
- R2 560k
- R3 1k
- R4 to R6 10k (3 off)

All 1/4W ± 10% carbon

See
SHOP
TALK
Page

Potentiometer

- VR1 47k miniature enclosed carbon preset

Capacitors

- C1 1000µ radial elect. 25V
- C2 1µ radial elect. 16V
- C3 100µ radial elect. 16V
- C4 100n ceramic
- C5 10µ radial elect. 16V

Semiconductors

- IC1 4060 14 stage counter
- IC2 4017 decade counter
- D1, D2, D5 1N4001 1A 50V diode (3 off)
- D3 15V 1.5W Zener
- D4 miniature red l.e.d. with mounting bezel
- Dx 1N4001 (number as required – see text)
- TR1 BD139 npn transistor

Miscellaneous

- T1 miniature mains transformer with 15V-0V-15V secondary rated at 100mA (3VA)
- RLA ultra miniature high power mains relay, 320 ohm coil with changover contact rated at 240V a.c. – see text

Three-way p.c.b. terminal block (2 off); printed circuit board, available from the EE PCB Service, order code EE788; mains 13A three-way connecting cable; fused 13A mains plug (see text); mains 13A trailing single socket; connecting wire; metal or plastic case (see text) approx. 100mm x 75mm x 40mm; Earth tag (for T1); fixings – see text.

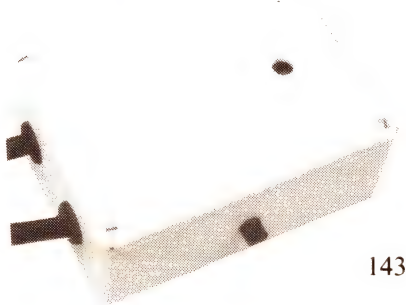
Approx cost
guidance only

£18

fixings should pass through the case. The two connecting leads must be secured with strain relief clamps and a correctly fused mains plug must be used.

It is important that the rating of the relay is not exceeded, the mains fuse should be rated accordingly so that the relay contacts cannot be overloaded by the appliance. The specified relay, which fits on the p.c.b., is rated at 10A a.c. (resistive) and 3A a.c. (inductive); since a dishwasher or washing machine represents a mainly inductive load (the motor) the unit should not be used to switch such an appliance rated at more than about 1kW with this relay.

Setting VR1 is the only adjustment you need to make to the circuit. Once it is set to its "once per 14 sec rate", the circuit is ready to be used. □



FOR YOUR ENTERTAINMENT

by Barry Fox



Double-Coated

Fuji is advertising "double-coated" video tape. What's that?

In short Fuji has taken an old and none-too-successful idea for improving the quality of audio tape and combined it with film technology to improve the quality of home video tape at little or no extra cost. The tape has a double layer coating of magnetic material instead of the single layer used on all video tapes so far. This gets round the long-standing problem that a video recording is really several different recordings made at the same time onto the same tape, all requiring different compromises in the magnetic material.

The highest frequency component of a video signal, which conveys fine detail black and white information, always records near the surface of a magnetic tape, because short wavelengths penetrate less than one micrometre into the material. Lower frequencies, which convey colour information, sound and picture synchronisation pulses, have longer wavelengths which penetrate deeper into the tape coating.

The high frequencies are best recorded with magnetic material made up from very small particles, and high magnetic coercivity (which strenuously resist magnetic change), while the lower frequencies are best recorded with larger particles which have lower coercivity (and change magnetic state more easily).

The same problem afflicts audio recorders, too, and over the last fifteen years many tape makers have tried to coat tapes with two layers, a top layer of fine particles with high coercivity and a lower layer of larger particles with lower coercivity. Early attempts at making two-layer tapes failed because the two layers did not stick together well enough and the top layer shed. Later two layer tapes are stable, but their cost is high because the tape has to pass twice through the machine which applies a liquid suspension of magnetic particles. This almost doubles production time and cost.

Now Fuji, which was originally in the film business and turned later to tape manufacture, has adapted film coating technology to video tape coating and coats both layers in one pass.

Modern colour film is made up from over ten separate layers, all applied in one pass through the coating machine. The trick is to squirt all the different light sensitive and dye chemicals from separate nozzles, and use laminar flow phenomena to prevent them mixing before drying in a multi-layer coating. Fuji now plays the same trick with two quite separate suspensions of magnetic particles in resin binder applied at the same time, without mixing.

The benefit of two layer coating,

as seen on the screen of a TV, is less random noise or "snow" in the picture and less streaking on strong, saturated colours. This benefit is particularly noticeable when tape shot with a video camera is edited, by copying from one recorder to another through several generations, each of which adds some extra noise. Because the double coating is a one pass process, Fuji plans to offer two layer tapes at the same price as today's single layer tapes.

Jukebox Technology

Anyone with an Astra satellite system, tuning in at night to the Lifestyle Channel (previously owned by W. H. Smith TV and now sold to a consortium which calls itself European Television Networks) will see the result of some very clever technology.

During the night hours ETN is broadcasting a satellite video jukebox. At the Jukebox headquarters near Carnaby Street in London, Philips professional video disc players can search out music video tracks from custom-pressed discs within one second of a computer instruction. The discs are changed every month to keep up with popular music tastes. The search command is under the control of a computer system which cost ETN and electronics company Telsis £1.5 million to design.

At any point during the day or night viewers can call in and phone the juke box. Their call is routed by Mercury line to a computer centre in Bristol which can handle around sixty calls a minute. A woman's voice, recorded digitally on Winchester hard computer disk, replies and offers the caller a choice of music titles. Each title has a number and the

caller keys that number in a keypad, if they are on a digital telephone exchange, or a rotary dial if they are on an old pulse exchange.

The computer then registers the number and selection and stacks it in a queue. Two and a half minutes later (if the call has been made during the night hours) the screen displays a notice saying the time when the tune will be played.

The original plan was to make the system voice responsive, so that callers could talk the number of the selected tune down the line. The designers achieved 98.5% accuracy, but never could build a system which would reliably cope with all accents across the UK; words like "five and nine" are just too hard to distinguish, especially in a city like Birmingham with a wide variety of different accents; ("five" becomes "fiver" and "nine" becomes "niner").

So the system was switched to work by MF or pulse dialled numbers. The Lifestyle channel has never been successful, but Jukebox has become a nice little earner. Children can order up music from ETN's Jukebox after their parents have gone to bed, or while they are out. The charge goes on the house phone bill.

Each Jukebox call is charged at 33p per minute (cheap rate) and 44p per minute at other times. Although there is a one minute cut-off, that means at least 33p per call. And if several people choose the same tune, the computer simply records all requests and takes the money, but plays the tune only once. Only then, when the tune has been played, does the computer schedule it again when the next paid request comes in.

FAX KILLER

It has happened to everyone. The house or shop or office phone rings and it is a fax machine.

Several times recently I have been driven to distraction by people who kept trying to send me a fax message on my ordinary speech line. Sometimes it has been in the middle of the night, from distant time zones. Another time it was over a Bank Holiday. Each time the sequence is the same. I answer the phone, hear a fax tone whistle, and hang up. A minute later the same thing happens. And it happens over and over and over again, at different intervals. The dimbo at the other end has keyed a number into their fax machine and left it at work. The fax machine cannot tell the difference between an angry human and a failed connection.

Twice recently the only way I could get any peace was to re-wire my telephone system temporarily to connect the fax to my speech line. I could then receive the

fax and silence the calls. On one occasion the message was a waffling release from a communications consultancy.

After vowing to kill with my bare hands, I had a constructive thought.

There is clearly a need for a fax machine which can recognise speech response. Apart from anything else this would help people who are trying to send a fax to a number which is answered by a recording which explains that the number has changed e.g. needs an extra digit. But so far I have seen no such machine, not even from British Telecom which both sells fax machines and intercepts calls with recorded announcements.

Until the likes of BT wake up to the market need for a smarter fax machine, the answer must be a new kind of "fax switch". This would connect to two lines, and automatically route incoming calls between the lines, e.g. from either phone line to fax machine, computer modem, ordinary telephone or answering machine.

REALISTIC®

PROGRAMMABLE

SCANNERS



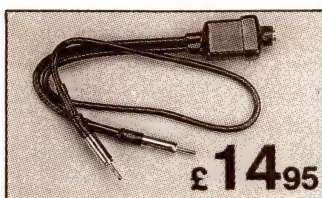
200-CHANNELS WITH 800 MHZ

£199⁹⁵

Realistic PRO-2022. Covers 68-88, 108-136 (AM), 136.005-174, 380-512 and 806-960 MHz. Selectable priority channel, two speed scan, lockout, scan delay. Jacks: 3.5mm headphones, external speaker, external DC power, BNC aerial input. Mains operation or 13.8 VDC neg. gnd. (Power cord extra). Memory backup requires 9v battery.

20-9127 £199.95

AM/FM SCANNER COUPLER



£14⁹⁵

Converts your AM/FM mobile car aerial into a full range monitor-scanner aerial, without harming AM/FM radio reception. Frequency range 25-1300 MHz.

20-9710 £14.95

16-CHANNEL MOBILE SCANNER

£99⁹⁵

Realistic PRO-2025. Covers 68-88, 136-174 and 406-512 MHz. Select up to 16-channels to scan and change your selection at any time. Features automatic two-second scan delay, memory backup, priority channel, lockout function, squelch and volume controls. Jacks: power, external speaker and aerial. 12 VDC neg. gnd. only. Measures: 45 x 140 x 175mm.

20-9146 £99.95

Tandy®

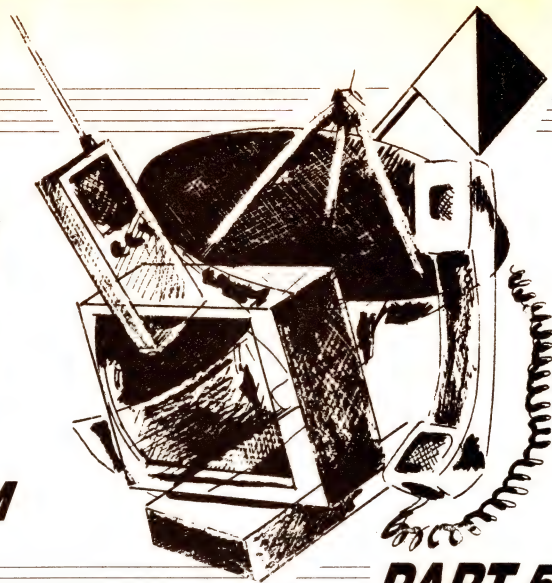
InterTAN U.K. Ltd., Tandy Centre, Leamore Lane, Walsall,
West Midlands. WS2 7PS Tel: 0922-710000

INFORMATION TECHNOLOGY

AND THE NATIONAL CURRICULUM

T. R. de VAUX BALBIRNIE

PART 5



THIS is the fifth in a 12-part series concerning Information Technology, Microelectronics and related matters in the Science National Curriculum. Readers are reminded that there is far more material presented here than is needed to satisfy the requirements of the National Curriculum. Much of it may be regarded as resource material from which ideas may be drawn as required. Those who have not been following the series are advised to read Part 1 (November issue) because this gives certain useful background information.

Last month we ended by looking at the range and uses of some microelectronic devices found in everyday life. This month we shall do some experiments using microelectronics than look at some means of detecting and measuring environmental changes using a variety of home-made instruments.

There are two approaches to doing microelectronic experiments. The first is to use ready-made modules and for anyone feeling his or her way this is probably the best way of proceeding. However, some cost may be saved and, perhaps, more experience and satisfaction gained by using basic components on a prototype board – most of the following details are given assuming that you are going to do this.

THE 555 TIMER

Microelectronics involves using *integrated circuits* (this point was made last month). One of the most versatile of these – and one which has been around for many years – is called the *555 timer*. Although there are now 555 timers based on different technologies, we shall be using the traditional type which is robust and well suited to amateur experimentation. There are some interesting investigations to be done using this. However, although the chip itself is very inexpensive, you will need a few other components to make it work. These are listed later.

The 555 timer can operate in two distinct modes – as a *monostable* and as an *astable*. A monostable is a circuit which, once triggered, will switch on for a certain time then go off. It will then remain off until re-triggered. This could be used for all manner of timing operations – as a

darkroom or kitchen timer, for example. Time periods may range from a fraction of a second to several minutes depending on the values of a pair of external components.

An astable, on the other hand keeps switching on and off continuously as long as a supply exists. With a slow pulse rate, this could be used for a flashing motorway sign. By using a higher speed – several hundred or thousand pulses per second – it could operate a loudspeaker and give a musical sound. This could provide the warning signal for a pelican crossing or, by using a keyboard to change the note, could be the basis of a musical instrument.

This latter use will be described in more detail later and could provide a useful link with other National Curriculum areas. Ready-made modules based on the 555 timer or a similar integrated circuit are available as monostables and astables. These are listed in science education suppliers' catalogues.

TIMER CIRCUIT BUILDING

Building circuits using a 555 timer in both monostable and astable modes makes a good exercise and one which can be related very easily to devices used in real life. It also gives confidence in handling integrated circuits and other electronic components.

One problem with using i.c.'s is making connections to the pins. It is not really practical to make these *direct* even if you are good at soldering. For making temporary circuits, it is best to use a solderless prototype board. There are several different types available but here the *Vero Plugblock* is specified.

After building the circuits, the components are simply removed from the board and may be used again indefinitely. Note that if any other type of breadboard is used, it will be necessary to translate the layout diagram into the new scheme. The Vero Plugblock has most of its contacts arranged in two sections of 29 rows, each having five holes (see Fig. 1). The spacing of the holes is 2.5mm making them suitable for direct plugging-in of integrated circuits.

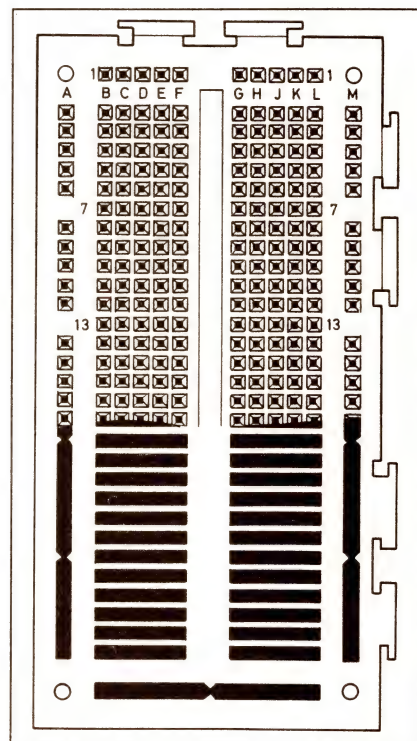


Fig. 1. Layout of the Vero Plugblock. The bold lines on the lower part of the drawing indicate how the holes are connected together.

The bold lines show how the holes are interconnected thus, component leads inserted into any of the five holes in a row will be connected together. Note that rows are not connected together across the centre line – if this is necessary, short bridging wires will be needed. Link wires are also needed to inter-connect separate rows of holes as required. The holes along the top are all connected together as are those to the left, right and bottom of the board – these are useful for the battery connections.

For the following experiments, you will need the components listed below. Note that the starred ones have been used in previous experiments and should already be part of your kit. Connections to the loudspeaker may be made using small crocodile clips, firm twisting of the wires

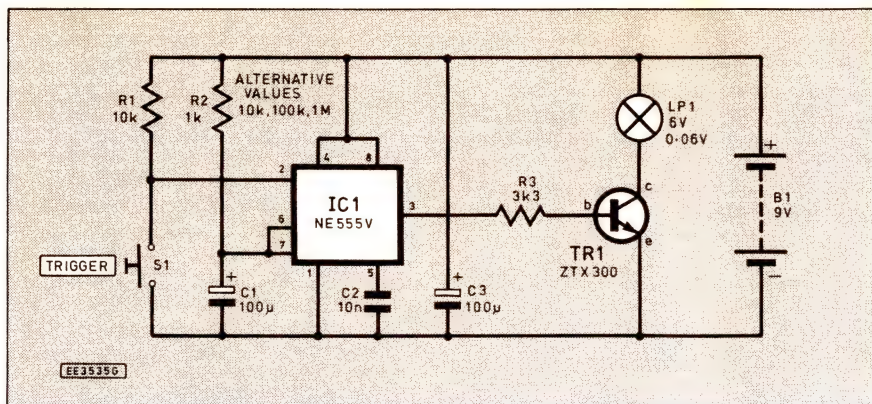


Fig. 2. Monostable circuit diagram.

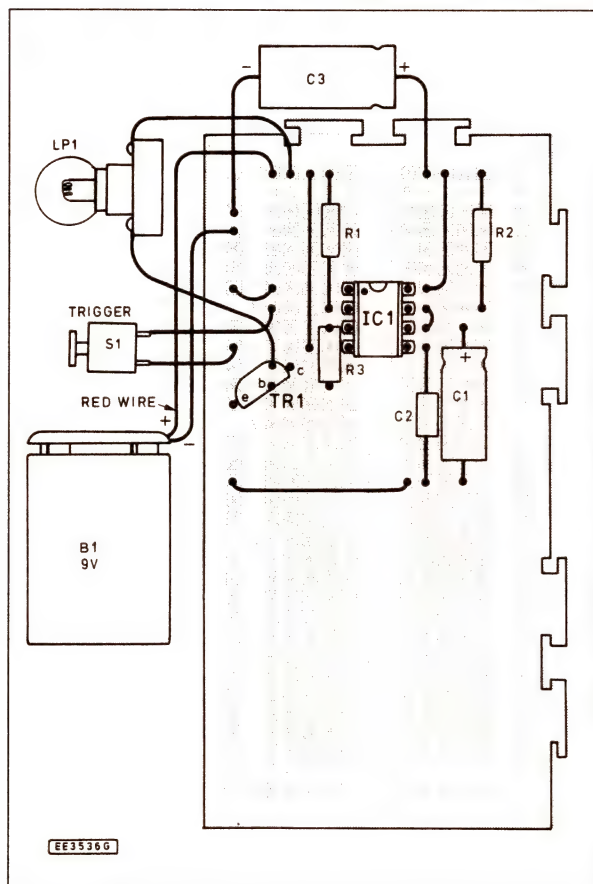
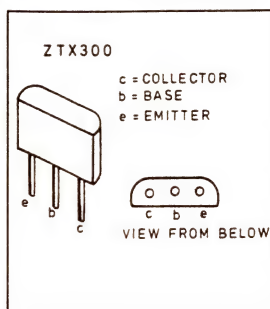


Fig. 3 (left). The Plugblock layout of the monostable circuit. It is essential that TR1 is connected correctly and that C1, C3 and IC1 are the correct way around.

Fig. 4 (below). The connections to TR1, compare this with Fig. 3.



onto the terminals or, of course, the wires may soldered into position.

Resistors

Note: it is now usual to express resistor values without the " Ω " (the unit of resistance) sign and without the decimal point – for example, 1k or 1k0 is 1 kilohm or 1000 ohms. 3k3 means 3.3k or 3300 Ω . 1M is 1 megohm or 1 million ohms.

1k – 2 off
3k3
10k – 2 off
100k
1M

All 0.25W 5% carbon.

Capacitors

Note: 1n is 1 nanofarad or 1 thousand-millionth of a farad (the unit of capacitance). 1 μ is 1 microfarad (one millionth of a farad). An axial capacitor has one lead protruding from each end as shown in Fig. 5.

100 μ axial electrolytic 10V (2 off)

10n ceramic
100n ceramic

Semiconductors

NE555V timer
ZTX300 transistor

Miscellaneous

Vero Plugblock
*6V 0.06A lamp and lamp holder
*PP3 battery and battery connector
*miniature loudspeaker – 60 to 80 ohms impedance
*miniature push-to-make switch
You will also need some short pieces of light-duty single strand wire of various lengths with the last 5mm of insulation removed from both ends to use as link wires. Do not use scissors to remove insulation – buy a pair of proper wire strippers.

THE MONOSTABLE

The circuit diagram for the monostable is shown in Fig. 2 – this may be helpful to some readers but it is not essential to un-

derstand it. It is only necessary to be able to build the circuit by putting the components in the right places on the breadboard, to be able to control it and to investigate what it does and the range of uses it could have in everyday life. This last point is very open-ended and may be used for countless activities of the investigative type.

According to convention, R1 and R2 are the resistors, C1 C2 and C3 are the capacitors, IC1 the integrated circuit and so on.

The Plugblock layout for the monostable circuit is shown in Fig. 3. The following four parts should be identified: (a) the push-button switch, S1, which is the input device and used to trigger the monostable (b) the integrated circuit, IC1, which carries out the process (c) the transistor, TR1, which amplifies the small output current from the i.c. and (d) the lamp, LP1, which is the output device and lights when the i.c. is on. In next month's article we shall see how an alternative output device – a relay – may be used instead of a bulb. This makes the circuit more versatile.

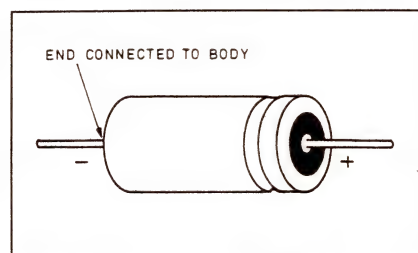
Refer to Fig. 3 and insert the components as shown taking care over the orientation of transistor, TR1 (see Fig. 4) and the integrated circuit (note the cut-out and/or spot on the body – see last month). The components may not be all exactly the same size as those shown in the diagram – however, by gently bending the end leads, they should fit the holes without difficulty.

Wire ends may be cropped so that the components fit more tidily and closer to the board and this also helps in avoiding bare wires touching one another and causing short-circuits. Do not remove too much end wire or you may find that the component will not fit into a subsequent layout.

Note that components C1 and C3 are a type of capacitor called an *electrolytic* capacitor and for this reason it is essential to connect them the correct way round. Body markings identify the negative end – if this is not clear for any reason, then the negative end is the one which is connected *direct* to the metal body (see Fig. 5).

Connect the battery holder, taking care over the polarity, and insert the battery itself. Trigger the circuit by pressing switch, S1, for an instant. The bulb, LP1, should light and go off soon afterwards. The alternative values of R2 will alter the

Fig. 5. An axial lead electrolytic capacitor. The negative end is usually marked on the plastic covering around the case.



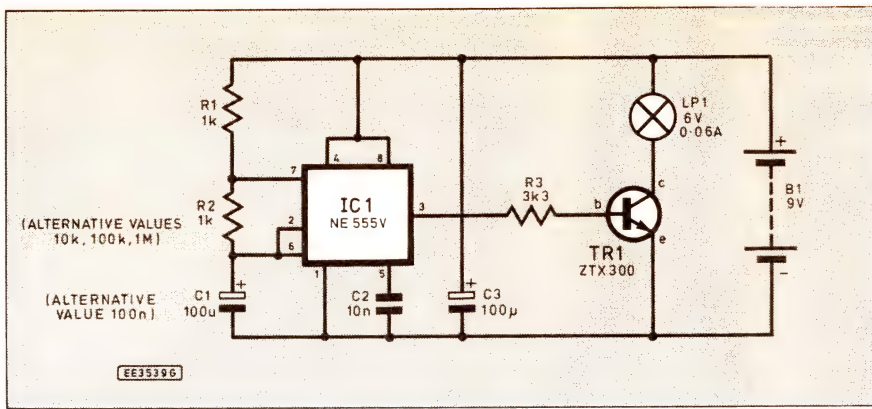


Fig. 6. Astable circuit diagram.

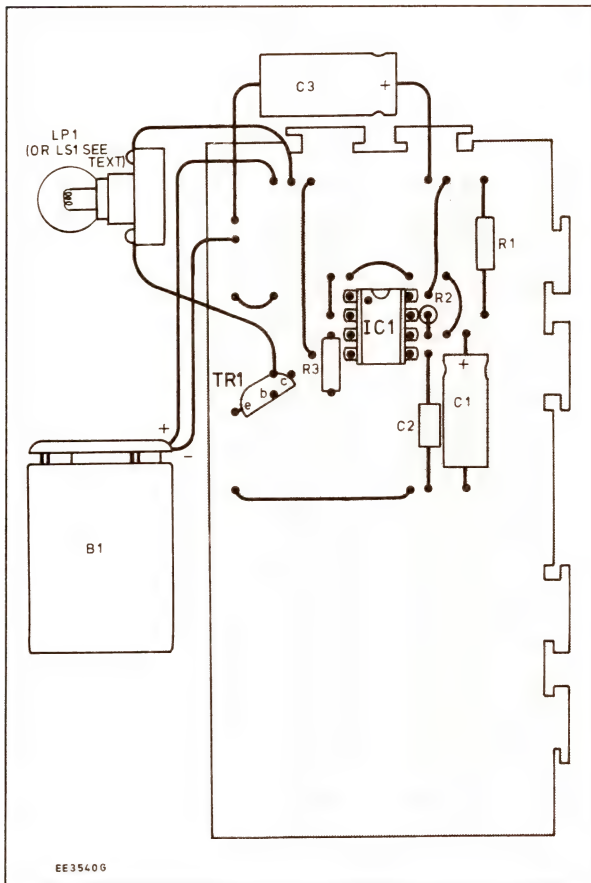


Fig. 7. Plugblock layout for the astable.

timing period – the larger the value the longer the timing will be. Insert these one by one to check this point.

THE ASTABLE

The astable shares most of the Plugblock layout with the monostable circuit. The circuit diagram is shown in Fig. 6 and the practical layout in Fig. 7. Build the circuit using $C1 = 100\mu$ to begin with. Connect the battery – the lamp should light, go off, come on and repeat rapidly. By changing $R2$ to the alternative values, the operating time may be altered – the higher the value, the slower the flash rate will be.

By returning to $R2 = 1k$ and the alternative value, $100n$, for capacitor $C1$, the time period will be so fast that the bulb appears to be on all the time. This is because the individual flashes are too fast for the eye to follow. Prove this by removing the lamp and lampholder

and connecting the miniature loudspeaker in its place. This will now give a high-pitched tone because the output pulses move the cone rapidly backwards and forwards – this vibration produces a musical note.

The values of $R2$ and $C1$ determine the rate of vibration of the loudspeaker cone and hence the pitch of the note produced – the faster the vibration the higher the pitch (there is a link here with National Curriculum music topics). Use the alternative values for $R2$ and check that various notes may be obtained. It would be possible to use a set of resistors to produce a musical scale. Push-button switches could be used to make a keyboard and connect the correct resistor for the note required.

Now we come to the second part of this month's work. This is to show how Microelectronics helps in the detection and measurement of environmental changes.



A range of Unilab sensors designed to allow environmental measurements. These can be used with computer interfaces or data loggers if required (Unilab Ltd., Blackburn).

ENVIRONMENTAL CHANGES

Environmental changes suitable for study include: light, temperature, sound level, radioactivity, pH, earthquake, oxygen and moisture content. However, we shall not look at all of these – the following are sufficient: Light intensity, Temperature, Moisture content and Sound level. This work could provide links with other areas – particularly biological ones – in the National Curriculum.

There is a difference between *detecting* and *measuring* and this point should be made clear to the children. If we notice, for example, that there is light in the room, we have *detected* light. If we notice there is a change in the light intensity – that is, it becomes brighter or darker, then we have *detected a change* in light intensity. If we come out of the cold into a warm room, we notice that it is hotter –

we have detected a rise in temperature.

Detection does not involve actual figures – for this we need a *measuring instrument* and this will tell us the quantity in appropriate units. For example, to measure the length of a piece of string, we use a ruler and this will tell us the length in metres or centimetres. To measure a temperature, we need a thermometer and this will read in degrees Celsius (centigrade) and so on. To measure environmental changes using an electronic circuit we need *sensors* – devices which respond electrically to the change being considered.

Our senses are good at *detecting* certain changes but not very good at *measuring* them. One reason for this is that our senses, unlike measuring instruments, are easily influenced by what they detected previously. For example, if someone came into a room from a warmer place, they would think that it was cool. If they came into the same room from somewhere even colder, they would think it was warm. It can't be warm and cool at the same time – only a thermometer will tell us what the temperature really is.

There are several excellent ready-made electronic instruments which may be used to measure environmental changes (see photographs). If these are available, they should be used. Unilab, for example, produce a wide range of such devices. An oxygen meter would be useful for several experiments in biology.

It is fun, though, and instructive to use microelectronics to make some instruments for yourself and this may be done very cheaply. Home-made instruments may then be compared with commercial ones in terms of accuracy, reliability, size, ease of use, cost, etc. They may also be compared in terms of ruggedness, range, cost, speed of operation, etc. with traditional instruments – an electronic thermometer with a mercury one, for example.

Since all the home-made circuits to be described are battery-operated, they are entirely safe in operation and may be freely handled by anyone. For those requiring a half-way stage – that is, something between purpose-made commercial instruments and those built using basic components – modular kits may be used. The Unilab Alpha system is an example. By connecting together the various modules, many different types of circuit can be made. Although complete kits are expensive, costs may be saved by buying only one of each module required. These are robust and, with careful use, will last indefinitely.

BUILDING CIRCUITS

The following assumes that you are going to build the circuits using basic components on the Vero Plugblock. Three of the circuits – for light, temperature and moisture level measurement – share a basic circuit. Which one of the environmental changes is to be measured simply depends on which sensor is used. The sound level measuring circuit needs some additional circuitry at the sensor end but still uses much of the basic circuit.

When using an electronic circuit to

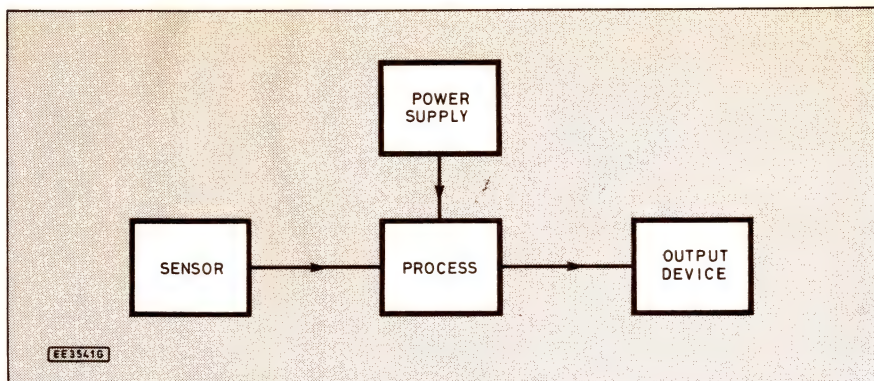


Fig. 8. Block diagram showing the basic parts of the measurement circuit.

measure the above changes the system may be regarded as having four parts – a *sensor*, a *processing circuit*, an *output device* and a *power supply* (see Fig. 8).

Most commercial instruments use a meter or digital display as the output device – readings are then given directly. In these circuits the cost of a meter or display has been avoided by using a rotary control and the measurement read off using a pointer-type knob and scale.

MEASURING ENVIRONMENTAL CHANGES

To measure light, temperature and moisture level you will need the following components. Remember to check your existing kit of parts – the starred ones have been used in previous experiments. For sound level measurements you will need some additional components which are listed later.

Resistors

ORP12 light dependent resistor (light sensor) or bead thermistor (temperature sensor) – resistance 150k at 25°C.

100k – 2 off

3k3 – 2 off

1M standard linear-track potentiometer and pointer-type control knob

Semiconductors

μA741C operational amplifier

*ZTX300 transistor

Miscellaneous

*Vero Plugblock

*6V 0.06A lamp in lampholder

*PP3 battery and connector

Single-core connecting wire

Knob with pointer for the potentiometer

The 741 operational amplifier (op-amp) looks very much like the 555 timer used previously, both being housed in an 8 pin d.i.l. package but here the similarity ends. The op-amp is a very different device.

Like the 555 timer, the 741 op-amp has been around for many years. A brief explanation of its action is given below but understanding this is not essential for making the circuits.

An op-amp has two inputs, the non-inverting (+) one and the inverting (–) one (pins 3 and 2 respectively for the 741) and one output (pin 6). It also has positive and negative supply connections (pins 7 and 4 respectively). Here, it is being used in *comparator mode*. Consider the light or temperature measuring circuits (see Fig. 9). R1 is a light-dependent resistor (LDR) for light or a thermistor for temperature measurement; these act as the sensor. VR1 is a potentiometer – this is familiar as the volume control on a radio.

In the circuit shown the LDR or thermistor, in conjunction with VR1, provides a certain voltage at the inverting (–) op-amp input. The value of this voltage depends on the light or temperature being sensed and the adjustment of VR1. A fixed voltage of approximately 4.5V is applied to the non-inverting input by the two resistors, R2 and R3.

When the (+) input voltage exceeds the (–) one, the op-amp switches on and the output is at positive battery voltage. When the (–) voltage exceeds the (+) one, the op-amp gives no output. Thus, under a range of lighting or temperature conditions, VR1 control knob may be rotated until the (+) input *just* exceeds the (–) one and the op-amp will switch on.

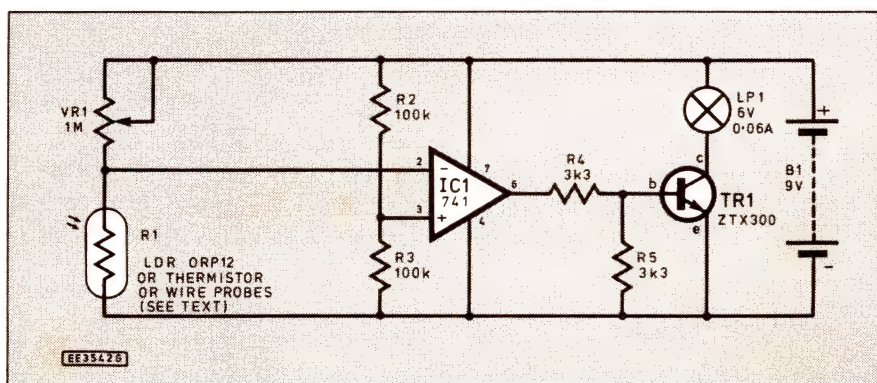


Fig. 9. Basic circuit for measuring environmental changes – light, temperature and moisture.

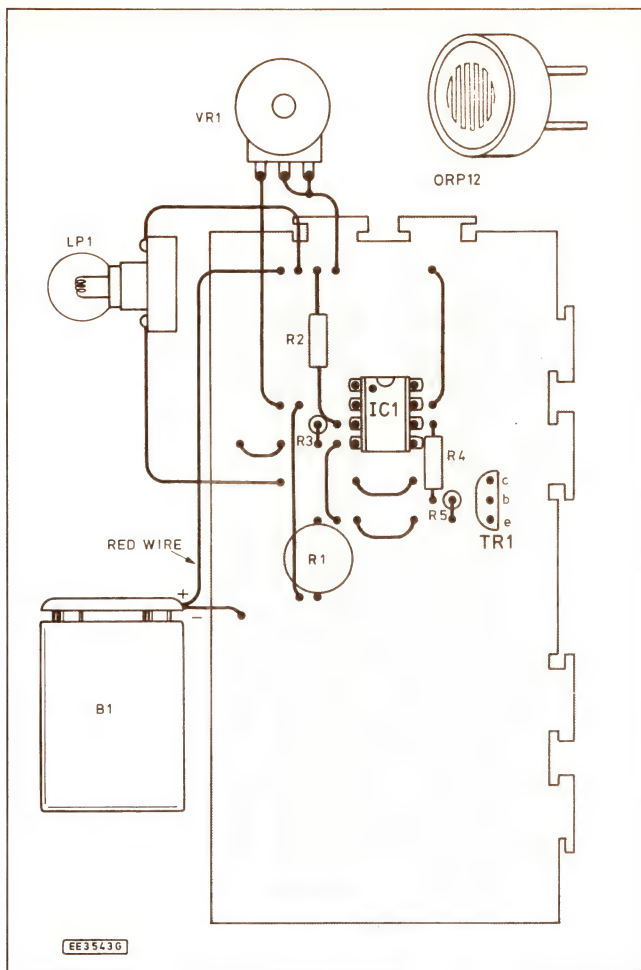
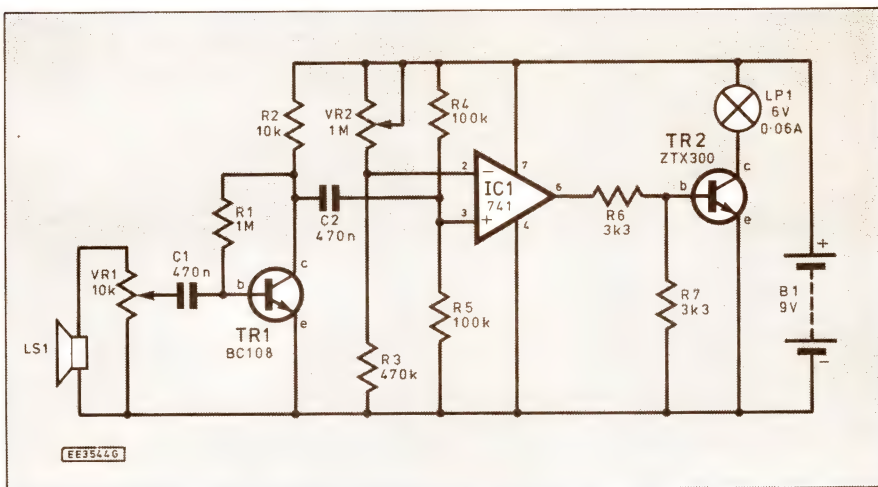
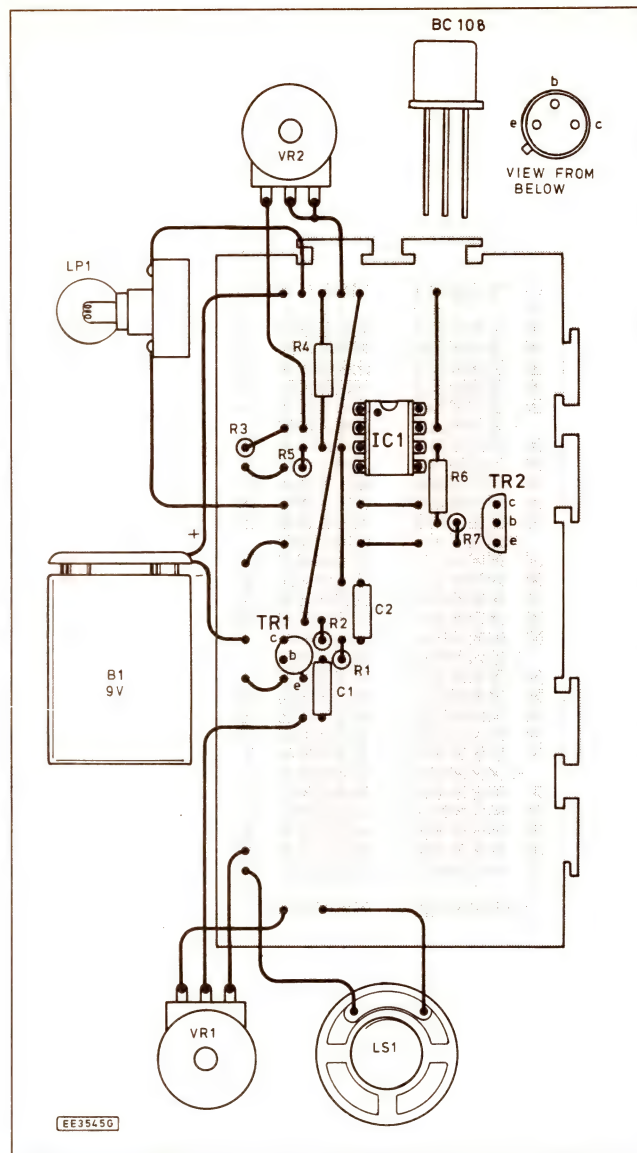


Fig. 10. Plugblock layout for light, temperature or moisture measurement.

Fig. 12 (right). Plugblock layout for sound level measurement.

Fig. 11 (below). Basic circuit for measuring environmental changes – sound levels.



By reading from a scale drawn under the control knob, the value of light level or temperature may be read off. The op-amp output is not sufficient to operate the lamp direct, so transistor TR1 amplifies the small output current for this purpose. Anyone wanting a more detailed explanation of op-amps should consult a text book.

To measure moisture content, two wire probes are used in place of R1. These are simply pushed into the soil, etc. whose moisture is to be measured. The damp

soil conducts electricity and acts as a resistor. The more water there is present, the lower its value will be. A voltage will then appear at the non-inverting input depending on the amount of water present and the rest of the circuit works in the manner already described.

BUILDING THE CIRCUIT

The Plugblock layout for measuring light, temperature or moisture content is shown in Fig. 10. Insert the components into the holders as indicated

using the LDR for light or the thermistor for temperature sensing. For moisture measurement, use two short wire probes with the last 5mm of insulation removed from each end. The exact arrangement could be the subject of experiment later.

Do not bend the end leads of an LDR or a thermistor too close to the body – they have a nasty habit of breaking off, rendering the device useless. Remember, the components you buy may not be exactly the same size of shape as those shown but they should still fit into position without difficulty.

Note the small cut out and/or spot on the op-amp body – this ensures that it is inserted the correct way round as shown. Note also the shape of the transistor, TR1, outline – again, this makes sure that it has the correct orientation.

Make the inter-row links using the short pieces of single-core connecting wire. Fit the control knob and leave VR1 adjusted to approximately mid-track position. Now make a careful check for errors before proceeding. Check particularly that IC1 and TR1 are the right way round. **Note that certain components can be damaged if connected incorrectly.**

Connect the battery holder with the correct polarity and insert the battery itself. Rotate the potentiometer spindle and

check that a "balance" may be obtained where the lamp is just off. Carry the circuit into different places and check that a new balance position may be obtained for differing light intensities or temperatures (according to which sensor has been used). If measuring moisture, check by dampening the fingers and touching the probes.

When the circuit is working correctly, VR1 may be attached to a piece of cardboard. A scale is then drawn showing brightness, temperature or moisture levels. It will probably be sufficient to use an arbitrary scale marked 0-10 but for temperature, the device could be calibrated against a mercury thermometer and a scale of true values used.

It is a good exercise to decide what light intensity or temperature is sufficient for normal working then check various places in the building to find out if each area is receiving enough light or heat. Note that when making light measurements, it is necessary to prevent the light from the bulb reaching the LDR or you may obtain some curious results.

Note: If you want to use the thermistor sensor for measuring the temperature of water rather than air, you will need to waterproof the body and leads completely. This is because water conducts electricity and would lead to false results.

SOUND LEVEL

For measuring sound levels, most of the basic circuit for light, temperature or moisture levels is used. However, some modification to the input stage is needed and you will need the following additional components. Note that stars have the same meaning as previously.

Resistors: *10k, 470k, *1M

Capacitors: 470n – 2 off

Semiconductor: BC108 transistor

*Miniature loudspeaker – 60 to 80 ohms impedance.

The miniature loudspeaker is the sound sensor – in this application it is being used in reverse – that is, as a microphone. The sound vibrates the cone and converts it into an electrical signal (readers who have been following the series will remember

this from the simple telephone described in Part 1). The signal is very small and needs to be amplified before it can be used as a practical sound level sensor. For this purpose, the BC108 transistor and associated components are used.

Build the circuit shown in Fig. 11 onto the Plugblock as shown in Fig. 12. Set VR1 to approximately mid-position and connect the battery. Adjust VR2 and find the point where the lamp is just off – after that, leave it alone. The 10k potentiometer is the level adjustment whereby the lamp can be made to operate at any chosen sound intensity. This circuit could be used for comparing the sound near, say, a main road, in a classroom, in the playground, near a source of music, etc. It could thus be used to study noise pollution.

Next month we shall begin by looking at the use of switches and relays in simple circuits. We shall also look at logic gates and their use in decision-making and simple control circuits.

EVERYDAY ELECTRONICS BINDERS



Don't let your valuable issues of EE get binned, burned or bitten (by the dog). Get one of our exquisite orange hard-back binders, slip each issue into it as you get them and you will always know where they are – we hope!

Binders to hold one volume (12 issues) are available from Everyday Electronics, 6 Church Street, Wimborne, Dorset BH21 1JH for £4.95 (£6.95 to European countries and £8.00 to other countries, surface mail) inclusive of postage and packing. Payment in £ sterling only please.

Binders are normally sent within seven days of receipt of your order but please allow up to 28 days for UK delivery – more overseas.

EVERYDAY ELECTRONICS

SUBSCRIPTION ORDER FORM

Annual subscription rates:
UK £18.50

Overseas £23 (surface mail)
£40.50 (airmail)

To: Everyday Electronics
6 Church Street
Wimborne, Dorset BH21 1JH

Name.....

Address.....

I enclose payment of £ (cheque/PO in £ sterling only payable to Everyday Electronics)
Access or Visa No.



--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Signature..... Card Ex. Date

Please supply name and address of card-holder if different from the subscription address shown above. Subscriptions can only start with the next available issue. For back numbers see the Editorial page.

EVERYDAY NEWS

MESSAGE FROM QUEEN VICTORIA

The British Library has a major new acquisition to add to its collections: A recording taken from a Graphophone cylinder that belongs to the Science Museum. Originally recorded 103 years ago and recently rediscovered, the cylinder may have the only surviving recording of Queen Victoria.

The Graphophone was invented in the United States, where it succumbed rapidly to the rival cylinder recording system developed by Thomas Edison. There are very few surviving Graphophone cylinders – made of cardboard with a wax-like coating – and this is the only one known in Britain.

The cylinder belongs to the Science Museum, which received it in 1929 from Sydney Morse's son. Morse is known to have gone to Balmoral to show the Queen the newly invented Graphophone cylinder recording system. He later described a cylinder made at Balmoral as "my most cherished possession and chiefest treasure". This may be the same cylinder.

Restoration

Using the custom-built technology of the National Sound Archive, a department of the British Library, this voice can be heard again through the Archive's listening facilities.

The National Sound Archive was initially called in because the technology to play the cylinder had disappeared. Using a modern electric phonograph and a variety of filtering techniques, including a new Computer Enhanced Digital Audio Restoration (CEDAR) system developed in association with the British Library, Conservation Manager Peter Copeland has been able to reveal what may be the Queen's voice.

The cylinder has three bands recorded on it. One has the shadow of a woman's voice but no words are distinguishable.

Another has a man's voice and some whistling, which may correspond to accounts of Queen Victoria's recording session at Balmoral. The third band has a woman's voice, and through heavy surface noise the words "Greetings ... the answer must be ... I have never forgotten" can be discerned.

Sight and Sound

The cylinder itself, together with the electric phonograph and a model of the Graphophone, are on display at the Science Museum, Exhibition Road, London SW7.

This recording (along with two million others) can be heard free of charge at the British Library National Sound Archive, 29 Exhibition Road, London SW7, open Monday-Friday 10am to 5pm (Thursday to 9pm). All listening is by appointment except a five minute programme featuring the "Queen Victoria" cylinder which can be heard on demand. There is also a fuller programme giving technical information.

MOBILE FAX

Being able to send written messages and receive faxes while you are on the move from location to location, in your car or even on a train, is no longer a science fiction pipedream claims British Telecom. With the launch of BT's new PF-1 portable fax, claimed by some to be the smallest A4 machine in the world, the fax no longer needs to be *wired* in to the telephone network.

Designed specifically for use over the Cellphone network, the machine incorporates features such as automatic answering – allows you to receive faxes while you are away from your car – and error correction facilities. You can also run off quick copies of important documents.

Using a data interface unit to link into the Cellphone network, the PF-1 is smaller than a sheet of A4, only a couple of inches deep, weighs just 6lbs and will work with most car or transportable phones. In the car, it draws power from the cigar lighter socket.

When you are on site, or for that matter on a train or boat, it uses its own rechargeable battery pack.

With the addition of an optional mains adapter it can be plugged into an ordinary BT socket.

"Its taken a while to come up with a genuinely portable mobile fax, at a price small businesses can afford", says BT's Les Huett. "But it has been worth the wait. Everyone who has tried it has been impressed by the extra freedom it offers", he said.



I.C.s Shrinking

A range of personal communications i.c.s in the Shrink Small Outline Package (SSOP) are being marketed by Philips Semiconductors. Claimed to be the world's smallest commercially available 20-pin package for this type of i.c., with a p.c. board footprint measuring only 4.5mm x 6.75mm, the SSOP occupies a mere one-third of the board space required by predecessors. In addition, its 1.5mm height makes it thinner; a key advantage in space-sensitive applications such as cordless telephones, pagers and pocket wireless systems.

The first products offered in the space-saving SSOP package are the NE/SA575DK low voltage compandor and the NE/SA605DK/615DK high-performance low-power FM i.f. system i.c.s, allowing designers currently using the SOL versions of these i.c.s to miniaturize equipment without changing the circuit design.

The compandor, which features a precision dual-gain control circuit and low supply voltage operation, can be used to reduce noise and boost dynamic range in a wide range of audio and radio communications applications. The FM i.f. system i.c. incorporates a mixer, oscillator, i.f. and limiter amplifiers, plus a quadrature detector, muting circuit, logarithmic received-signal-strength indicator (RSSI) and voltage regulator.

Philip Tizzard has been appointed Managing Director of Siemens' Electronic Components Group based in Sunbury-on-Thames. He succeeds Alan Wood, who was recently appointed the managing Director of the Company's Energy & Automation Group in Manchester.

★ ★ ★

New Franchise

Alpha Industries have appointed Cirkit as their first UK distributor. Chosen from stiff competition, Cirkit will be stocking a carefully selected range of Alpha's u.h.f. and microwave diodes, Gunn oscillators and MMICs. All are featured in the latest Cirkit 1992 catalogue.

With a turnover of more than \$60 million, the Boston based company have been expanding into the consumer market from a largely military background, Bob Nichols, Alpha's UK Director of Sales said, "we were particularly impressed by Cirkit's understanding of how the UK r.f. market is developing, which fits in well with our own plans, not just for the UK but Europe as well". "We have a fantastic product range, but targeting potential users has to be very specific, which is why Cirkit won the right to distribute Alpha's components."

Emphasising the need for service, Richard Bulgin added "we will be holding stock of all the components featured in our new catalogue and working closely with Alpha for any special requirements". The Alpha range is set to complement Cirkit's existing r.f. franchises from Toko, Micrometals and Uniden.

... from the world of electronics

TOP MARKS

The professional outlet of Maplin Supplies has been awarded the prestigious British Standards Institute "Kitemark" for their products and components. The award is the Institute's BS5750 Certificate of Quality.

To mark the occasion and to present the award, David Tripper, Minister for the Environment and Countryside, paid a visit to the Maplin warehouse in Wombwell, Barnsley. When presenting the BSI award, the Minister congratulated managing director, Roger Allen, on the company's achievement. "The Award" he said "marks a significant milestone in the fortunes of Maplin."

In reply, Roger said that "customers are increasingly demanding BS standards for their components. The already high quality of our products will be enhanced by the award of the certificate - the culmination of extensive assessment by the BSI Quality Assurance team."

The Wombwell warehouse services over 7,000 product lines from over 500 suppliers, to meet over 10,000 orders a week and some 500,000 customers world-wide.



US/RUSSIAN UNION

The California company that has been pioneering the commercial development of the Russian television industry, Comspan Inc., has been selected as the exclusive US representative of the Union of Electronics of Russia.

Sanctioned by the Russian Parliament under former Prime Minister I.S. Silaev, the Union of Electronics operates under the administration of the Innovation Council of Russia, which was formed to help selected industries in the transition to a free-market economy.

The Electronics Union was formed in January, 1991 by a group of electronics engineers and entrepreneurs, many of whom were associated with the USSR's sophisticated defence industry. The Union is headed by Dr. Eugene Bugaetz, a member of the Russian Parliament and well-respected Soviet scientist.

Comspan, Inc., through its Business Development Consulting Division, headed by Phillip Quetschke, will provide business development and strategic planning guidance to the Union. In addition, Comspan

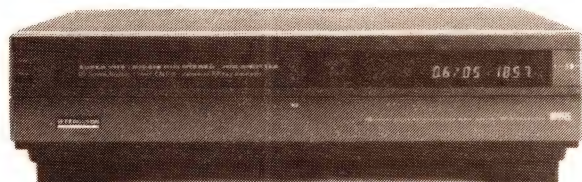
will organize the Union's activities in the United States in regards to licensing technology from or to Russia, and in establishing business relationships or joint ventures between entities of the two countries.

The first major goal of the Union is to create a database of inventions, technological research and engineering expertise. According to Mr. Bugaetz, "Because the defence and electronics industries' priority claim on resources has now been nullified, there is a great resource of highly-qualified engineers and scientists with innumerable technologies and inventions available for commercial adaptation and exploitation. There is enormous intellectual potential among Russian electronic professionals just waiting to be tapped and put to good use."

Briticent International, one of the UK's leading electrical and lighting distributors, has been purchased by Otra, the Amsterdam based wholesaling group in a deal worth over £23 million.

Otra has 150 branches in Germany and Holland with sales in excess of £800 million. The company's main shareholder is the French electrical distributor Sonepar, which has 450 branches in France, Spain, Italy, Portugal, Canada and Russia. With a combined turnover of £2 billion Otra and Sonepar together claim to have over 10 per cent of the Western electrical distribution market.

WIDESCREEN VIDEO



A top-end Super VHS VCR capable of recording and playback in 16 by 9 "widescreen" mode has just been announced by Ferguson. Priced at around £799.99, the Videostar FV59S is a state-of-the-art Super VHS machine with NICAM hi-fi stereo, 8-hour long play and a sophisticated "Jog Shuttle" control on its remote handset providing the precise frame control of a video editing machine.

A principal benefit of the "widescreen capability" is its ability to play back pre-recorded 16 by 9 format tapes. As it senses a "widescreen" tape, the VCR will also automatically send a code to switch a "widescreen" compatible TV to 16 by 9 mode. Ferguson is working closely with a number of major software companies to ensure that a comprehensive supply of video titles will be available in "widescreen" format in the near future.

In addition to playback of "widescreen" tapes, it is also fully capable of recording and

playback from 16 by 9 broadcasts when they commence. Other features include 4-head dual azimuth operation, an automatic head cleaner to maintain optimum picture quality, and a on-screen timer.

Editing

The jog shuttle remote unit is claimed to simplify cueing and invisible editing by providing variable tape speed control for editing purposes, and can also be used for convenient timer programming, setting the clock and channel selection. In addition, a "Retake" function which shuttles videotape backwards or forwards whilst in record pause mode can also be accessed from the jog shuttle, permitting editing without having to return to tape playback search modes. An assemble edit control allows easy, accurate tape editing when re-recording or assembling footage from a camcorder or perhaps another VCR, and is particularly useful when editing out commercials whilst recording a film.

Diary Dates

March '92

9-11

10th International Zurich Symposium and Tech. Exhibition on Electromagnetic Compatibility, Switzerland. (.4137) 82 1131)

All Formats

8 Scotland
14 London

Computer Fairs (0926 613047)

- City Hall, Candleriggs, Glasgow.
- Horticultural Hall, Greycoat Street, Westminster.

15 West
21 East Midlands
22 North

- Brunel Centre, Temple Meads, Bristol.
- Donington Park, J23A, M1.
- University Sports Centre, Calverley Street, Leeds.

April '92

12 North East

- Northumbria Centre, Washington, A194 (M).

26 West Midlands

- National Motorcycle Museum, J6, M42.

May '92

16 London

- Horticultural Hall, Greycoat Street, Westminster.

17 West

- Brunel Centre, Temple Meads, Bristol.

National Vintage Communications Fair (0398 331532)

3

Pavilions Hall, National Exhibition Centre, Birmingham.

A one-day event for specialist collectors and others interested in buying and selling vintage radios, telephones, televisions, jukeboxes, gramophones, records and other related mechanical-music items, ancient or modern, in order to pursue the enjoyment of their hobby.

AUTO GARAGE LIGHT

A. R. WINSTANLEY

No more fumbling around in the dark when parking the car in the garage at night. The headlights trigger the garage light for a preset time period - daytime override included.

WINTER is upon us at the time of writing, which highlights the inconvenience that the author experiences when garaging the car at night after a hard day's work at the office. After parking the car at night, it can be quite a job to fumble around in the dark garage in search of briefcase, coat and house keys, and so this project was designed in order to throw a little light on the matter (literally).

This garage light control unit will automatically operate the garage's electric light for a pre-set period, and is activated by the car's headlamps as the vehicle enters the garage. It is also automatic in that it will only operate during the night-time hours, once ambient light levels have dropped below a pre-determined level.

The Auto Garage Light has been designed to be versatile to allow simple installation in several configurations, as shall be seen. The device is a mains-operated project and may require some experience or knowledge of domestic wiring, but installation is quite straightforward and involves minimal interference with existing wiring.

HOW IT WORKS

The unit to be described incorporates several distinct sections as detailed in Fig. 1. To outline the principles of operation,

when the car is driven into the garage, the light from the headlamps falls upon a photo-sensitive device mounted inside the garage. This sends a triggering signal to a monostable ("one-shot") timer which starts timing for a period of up to about five minutes or so.

The timer is connected to a mains-rated relay, the contacts of which are in parallel with the existing light switch. Hence, the electric light in the garage will illuminate for a preset time period (the monostable period), long enough to get one's coat etc. out of the car and to lock up with the convenience of actually being able to see what you are doing for a change!

Precautions have to be taken to ensure that the system is not "fooled" by daylight, which would cause the device to mistake sunlight for the car headlamps and trigger the electric light.

A daylight override is therefore included in this design. This takes the simple form of a second photocell which is mounted near the window, for example, or if the garage does not have one, outside where it can watch for dusk and dawn. This second photocell sends a "reset" signal to the timer to prevent it from operating during daylight hours and will automatically activate the circuit again when the ambient light has dropped to a preset level.



Variable controls are incorporated to permit adjustment of the timer period, sensitivity to the headlights and dusk/dawn switching point. A further feature permits the provision of an extra electric lamp output, in case a light is not already fitted in the garage.

The Auto Garage Light was designed to plug directly into a mains socket, although skilled and experienced constructors will be able to wire directly to a fusebox, or a spur, for example. Obviously, such installation work *MUST* be carried out by a competent electrician if any doubts exist. To simplify construction, all components are mounted on a single p.c.b. which includes most mains interwiring for added safety and ease of assembly.

CIRCUIT DESCRIPTION

The circuit diagram of the Auto Garage Light is shown in Fig. 2 where the various sections can be seen. The circuit is centred around a twin operational amplifier chip type LM358 although other pin-compatible chips have been proven to function equally well.

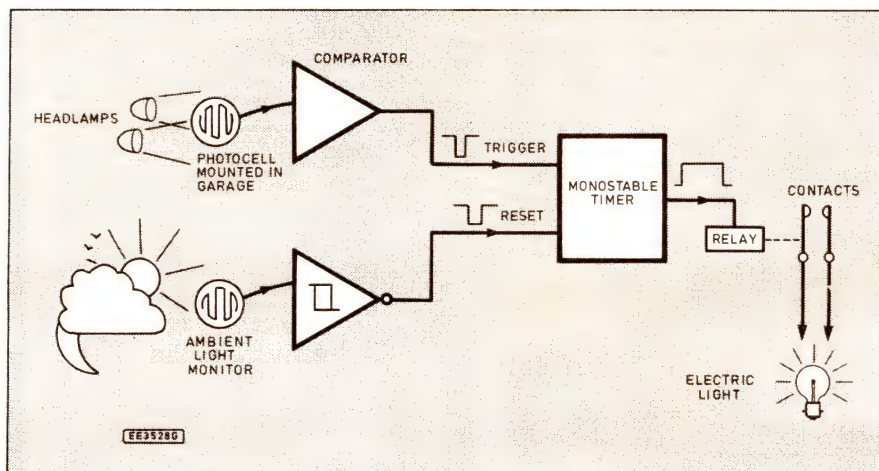
As indicated earlier, this circuit utilises two economical photo-conductive cells or light-dependent resistors (l.d.r.s) similar to the ORP12 type. The first l.d.r., R3, can be considered as a "daylight/night-time detector" and is connected to form a potential divider with preset resistor VR1. It is located in a position where it can monitor ambient light levels.

The "Day/Night" sensor, which detects when dusk is approaching, is formed by IC1a and associated components and will activate the Auto Garage Light circuit when the light has fallen to a predetermined level. As ambient light increases, the unit is de-activated - the circuit therefore prevents the electric light from being unnecessarily triggered during daytime.

The output from the potential divider network is taken from the wiper of VR1 and is connected to the inverting (-) input pin 6 of IC1a; a simple fixed divider comprising resistors R1 and R2 provide a reference voltage of 50 per cent of the supply rail to the non-inverting (+) input pin 5. The supply voltage is approximately 12V (see later) and thus pin 5 is held at about 6V. Ignoring R4 for a moment, the op-amp therefore forms a simple comparator circuit, since it "compares" the voltages present at its two inputs.

When pin 5 is more positive than pin 6, then the output (pin 7) swings "high", to almost the supply rail voltage. Conversely, should the potential at pin 6 exceed that at

Fig. 1. Block diagram of the Auto Garage Light.



pin 5, then the output will swing “low”, to approximately one volt or so.

Since the resistance of l.d.r. R3 changes inversely to incident light levels, the voltage at pin 6 will fall when the ambient light level increases, and rise when light upon it reduces. Thus, the output of IC1a can be made to switch high or low by the change of light level which is monitored by l.d.r. R3, such that in darkness (R3 resistance high) pin 7 is low, and vice versa.

The exact point at which the switch-over from high to low takes place can be determined by the setting of preset VR1. This can be trimmed so that each installation can be individually tuned to prevailing conditions.

Of course, the gradual onset of darkness is a very slow change over several hours. The gain of the op-amp is so high that, in comparator mode, only a tiny fraction of a voltage difference need exist between the

approaching the triggering level (itself set by VR1).

Resistor R4 introduces an additional side-effect in the operation of the Schmitt trigger. When the output switches either high or low, this effectively places R4 parallel with resistors R1 or R2 respectively. This can be considered as altering the values of R1 and R2 (to roughly 7.6k), and has an important effect upon the reference voltage at pin 5.

When IC1a output is low, resistor R4 can be considered as parallel with R2. By voltage divider action, the output voltage from the divider connected to pin 5 is:-

$$V_{ref} = \frac{(\text{combined value of R2 and R4 in } \parallel)}{(\text{total resistance of voltage divider})} \times \text{Supply Voltage}$$

R2 and R4 in parallel are 7.6k and thus the reference voltage at pin 5 is now not 6V but 5.18V i.e. $(7.6k \div 17.6k) \times 12$.

Alternatively, when pin 7 is high, R4 is now in parallel with R1, and the reference voltage becomes:-

$$V_{ref} = \frac{R2}{R2 \text{ Plus (value of R1 and R4 in } \parallel)} \times \text{Supply Voltage}$$

Hence the reference voltage is now about 6.8V: $(10k \div 17.6k) \times 12$.

Note: to calculate the value of two resistors in parallel, the formula is:

$$R_{total} = R_a \times R_b / (R_a + R_b)$$

There is now a difference between the point at which the circuit can switch high and the point when it must switch low, because the reference voltage at pin 5 (against which the signal voltage from l.d.r. R3 is compared) is changed by the inclusion of R4. This difference in switching points is called “hysteresis” and is a fundamental characteristic of Schmitt triggers.

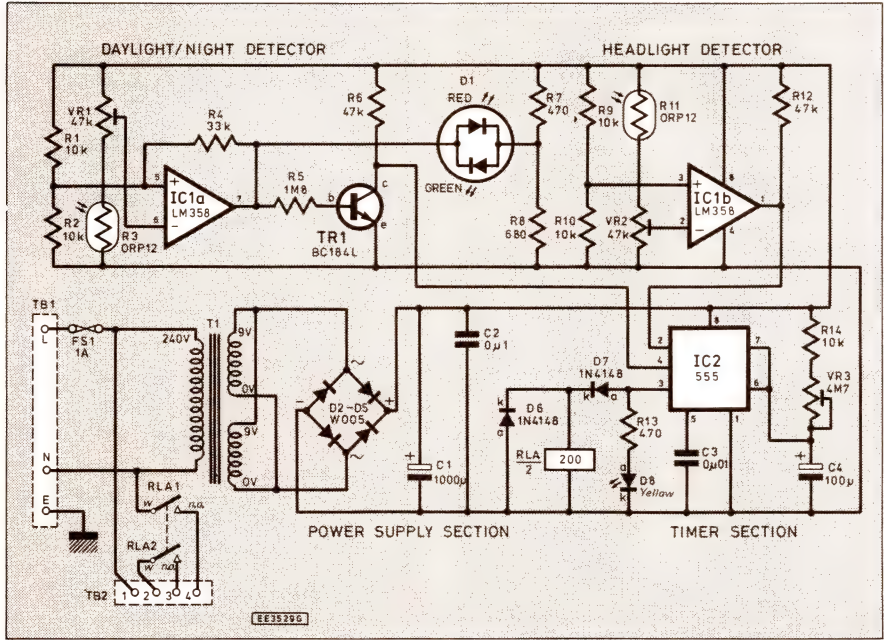


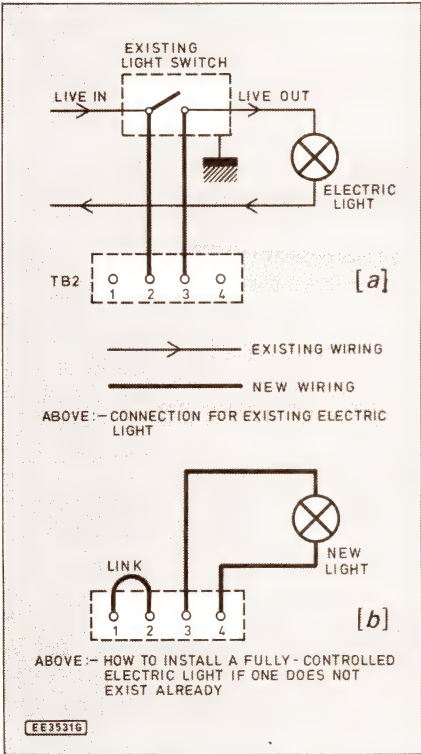
Fig. 2. Complete circuit diagram for the Auto Garage Light. The installation of the unit in an existing garage light circuit is shown in (a) and how to install a light if one does not exist is shown in (b).

non-inverting (+) and inverting (-) inputs of IC1a and the device will amplify this and switch over the state of the output. Without any feedback between the output and inputs, the amplification factor or “open loop gain” of the LM358 is up to 100,000 and so the i.c. will multiply the difference between the two inputs by this factor, making the circuit very sensitive to differences between the inputs.

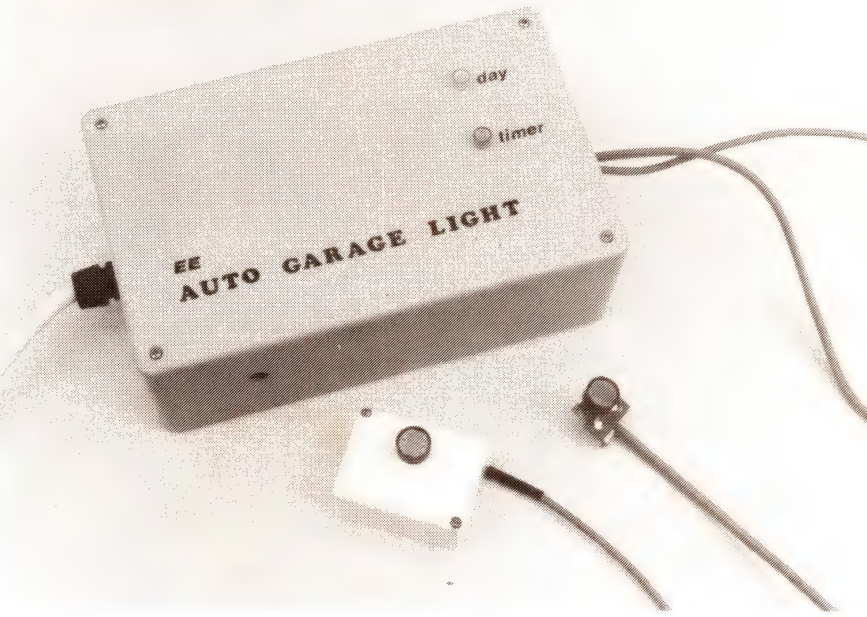
POSITIVE FEEDBACK

However, it was decided to further improve the switching characteristics of the circuit by including resistor R4 to introduce positive feedback. The i.c. then forms a Schmitt trigger, a circuit which is excellent for converting a very slowly-moving signal (l.d.r. output) into a very rapid on-off switching action.

Basically, once the output starts to switch high, R4 transmits a positive-going signal back to the non-inverting input (pin 5) of the op-amp, which accelerates the positive-going tendency of the output even more. This removes any tendency for the comparator to “jitter” in an intermediate state where the l.d.r. R3 resistance is just



The completed garage light controller showing the Day/Night and Headlight sensors.



A graphical summary of operation of this Schmitt trigger is shown in Fig. 3 which plots output against the input from the l.d.r. R3, and is a classical characteristic of this type of circuit. In practice the circuit will trigger when the ambient light level has fallen to a certain level but the light must increase back beyond that level before the circuit switches back again.

Connected to the output of IC1a is a bi-colour l.e.d. D1 and this will glow red when the op-amp output is high (daylight conditions) to indicate that the circuit is disabled, and green when the op-amp output is low (circuit operational). This will prove especially useful during setting up. Resistors R7 and R8 provide a voltage drop for each l.e.d. chip.

HEADLIGHTS DETECTOR

The other op-amp, IC1b, is also connected as a comparator circuit but this time it was not considered necessary to add positive feedback. R11 is another photoconductive cell (l.d.r.) which is mounted in the garage at a spot where the car's headlights will shine on it. This time, when light falls upon the photo-resistor, the inverting input (pin 2) will be forced towards the positive supply rail and the output will swing low.

Resistors R9 and R10 set up a reference voltage at pin 3 (the non-inverting input) and VR2 is another preset which controls the sensitivity of the circuit, i.e. how brightly R11 must be illuminated by the car headlights before the comparator switches over.

The output from IC1b ("headlights detector") drives the trigger terminal (pin 2) of the 555 timer chip, IC2. The timer requires a voltage of two-thirds of the supply rail or less in order to commence timing, and so the 555 is triggered when l.d.r. R11 detects the car headlights, the trigger terminal being driven low by IC1b.

Unlike the trigger input, the reset terminal (pin 4) of IC2 requires a voltage of

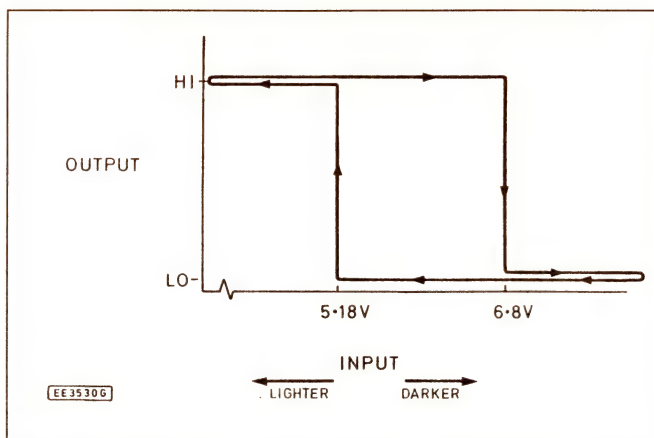


Fig. 3. Graph of Schmitt trigger characteristics.

0.7V maximum for the device to reset. The output of IC1a can be well over one volt when "low" and so a transistor switch TR1 was included which also inverts the output signal from pin 7.

Therefore, when IC1a output goes high (daytime conditions), transistor TR1 saturates and the collector falls to about 100mV or so. This provides a suitable reset signal for the timer chip, with the result that during daylight hours, the timer is disabled (reset pin held low by TR1) and cannot operate; this will override any signals present at the timer's trigger terminal.

TIMER

The timer itself is a standard monostable arrangement which will generate a fixed period delay when triggered at pin 2, unless the reset pin 4 is low. The period is determined by resistor R14, preset VR3 and capacitor C4 and is about eight minutes maximum. VR3 can be trimmed to change the period as required.

The output of the timer, pin 3, goes high during timing and this will illuminate l.e.d. D8 – a useful indicator during initial installation. The relay RLA is also energised during timing, diode D7 preventing latching up or relay chatter which sometimes occurs, and D6 shunts away any reverse voltage ("back e.m.f.") generated by the relay coil when it de-energises.

POWER SUPPLY/MAINS SWITCHING

Turning to the power supply and mains

switching section, mains input voltage is applied to a three-way terminal block TB1, via protective fuse FS1 and is stepped down by transformer T1 to 9V a.c. and both secondary windings are in parallel. This is then full-wave rectified by the bridge rectifier D2-D5; this is smoothed by the reservoir capacitor C1, C2 helping to decouple any noise and spikes. The result is a d.c. unregulated supply of approximately 12V-13V which is the main supply rail for the circuit.

The specified relay RLA has two sets of changeover contacts, of which the normally-open contacts are employed to switch the electric light. In fact, the circuit has been arranged to be more versatile, and will permit not only an existing lamp to be operated, but also enables the constructor

COMPONENTS

Resistors

R1, R2	10k (2 off)
R3, R11	ORP12 light dependent resistor (2 off)
R4	33k
R5	1M8
R6	47k
R7	470
R8	680
R9, R10	10k (2 off)
R12	47k
R13	470
R14	10k
All 0.25W 5% carbon film	

See
SHOP
TALK
Page

Potentiometers

VR1, VR2	47k min. preset, horizontal
VR3	4M7 min. preset, horizontal

Capacitors

C1	1000µ axial elect., 25V
C2	0µ1 polyester
C3	0µ01 polyester
C4	100µ axial elect., 25V

Semiconductors

D1	bi-colour l.e.d.
D2-D5	W005 50V 1.5A bridge rect.
D6, D7	1N4148 signal diode (2 off)
D8	yellow l.e.d.
TR1	BC184L npn silicon transistor
IC1	LM358 or 1458 or TL082CP twin op-amp
IC2	NE555 bipolar timer

Miscellaneous

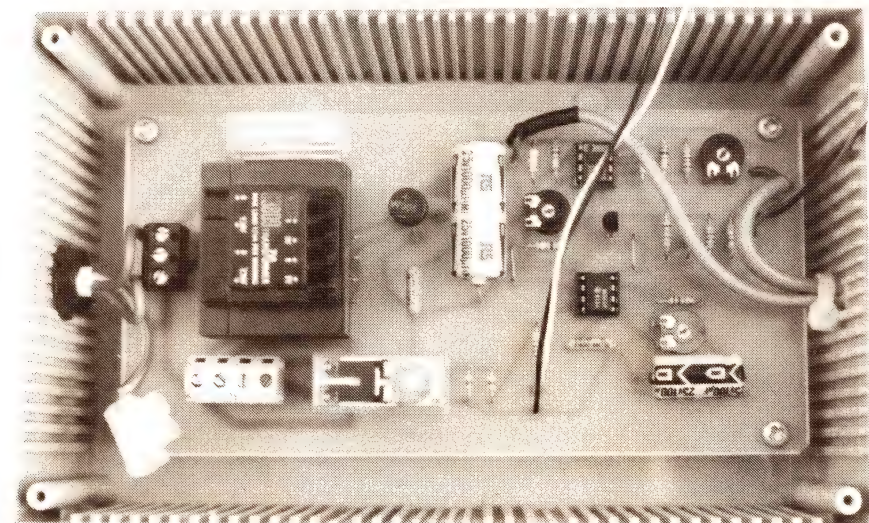
T1	Mains transformer: 240V primary; twin 9V 3VA secondaries (6VA total)
FS1	20mm p.c.b. mounting fuseholder c/w 1A fuse
RLA	Min. p.c.b. mounting 12V 200ohm coil relay, with d.p.d.t. mains rated (240V a.c. 5A) contacts
TB1	3-way mains rated p.c.b. mounting screw terminal block
TB2	4-way mains rated p.c.b. mounting screw terminal block

Plastic box, size 115mm x 185mm x 62mm; insulated p.c.b. mounting pillars (4 off); l.e.d. lens-clips, 1 clear, 1 yellow; 1.00mm² twin-core and Earth wire; cable, solder etc.

Printed circuit board available from EE PCB Service, code EE786.

Approx cost
guidance only

£19
plus case



to connect a light to the unit if the garage does not already have lighting installed.

The electric light is connected to the four-way terminal block TB2. To automate an existing light, simply connect terminals TB2/2 and TB2/3 in parallel across the light switch. Contacts RLA2 will then close when IC2 is timing, and this will in effect short out the light switch to illuminate the electric light.

If however no light and/or light switch exists, then a link wire can be inserted between terminals TB2/1 and TB2/2 which connects the live (L) supply to RLA2. The live output is taken from terminal TB2/3 to a new light which can be installed by the constructor in the garage. The circuit returns to terminal TB2/4 where it is con-

nected to neutral (N) through relay contacts RLA1.

The mains supply can be taken from a fused 13A outlet (as in the case of the prototype) or experienced constructors will be able to take a suitable supply from the domestic fusebox. In its basic configuration using the existing light switch, installation is kept very straightforward and the modifications to any existing electrical wiring are very simple, but this depends on whether a 240V supply already exists in the garage.

CONSTRUCTION

The whole of the circuit for the Auto Garage Light is constructed on a specially designed printed circuit board (p.c.b.).

This includes all mains interwiring which simplifies assembly.

However, due to the presence of mains voltages, extreme care must be taken when finally installing and setting up the unit. The board should be tested using the low voltage method outlined under the "Testing" heading.

The printed circuit board component layout and full-size copper foil master pattern is shown in Fig. 4. This board is available from the *EE PCB Service*, code EE786.

The p.c.b. measures 160mm x 82mm and the prototype unit was housed in a plastic box of dimensions 185mm x 115mm x 62mm approximately. Before commencing work on the circuit board, simply use the empty p.c.b. as a template for drilling the p.c.b. mounting centres in the box.

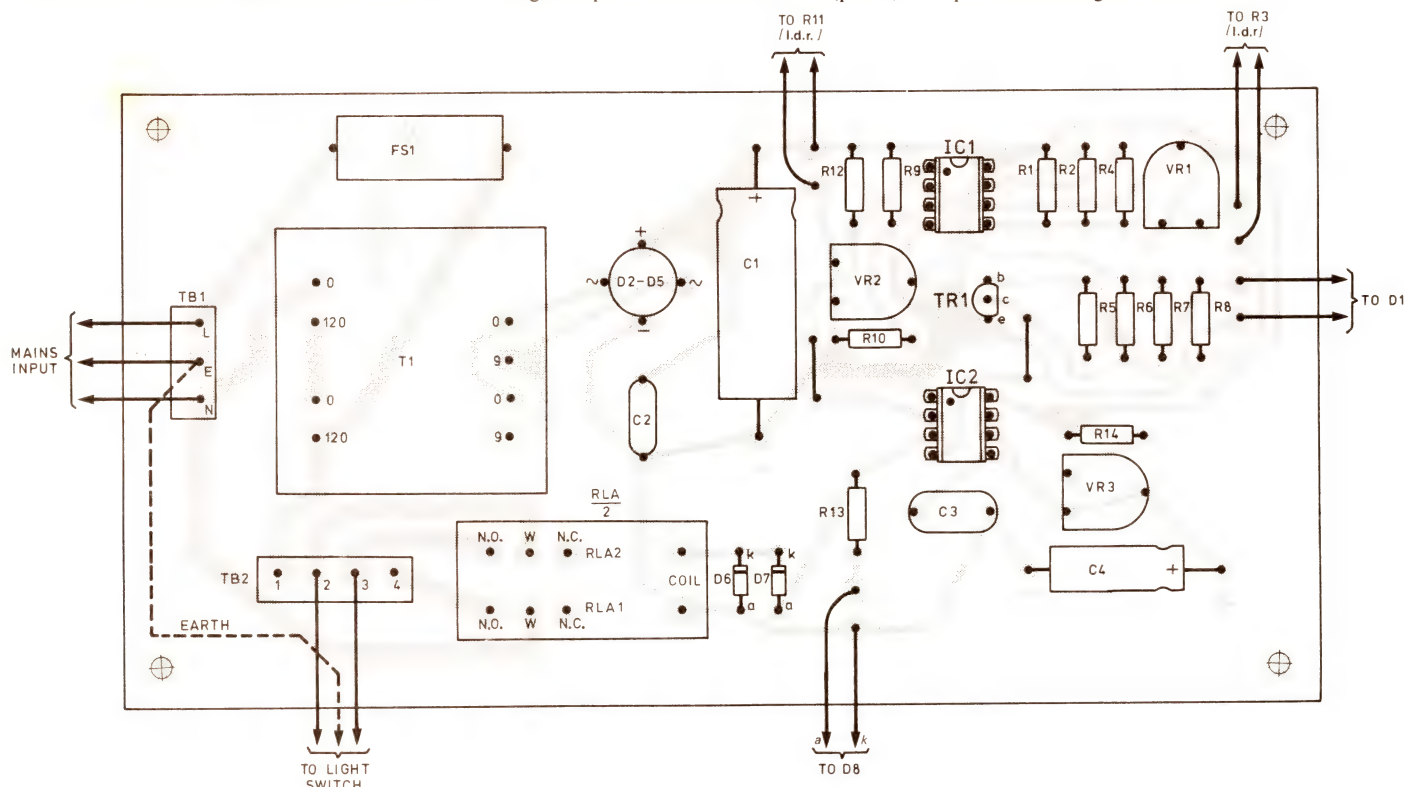
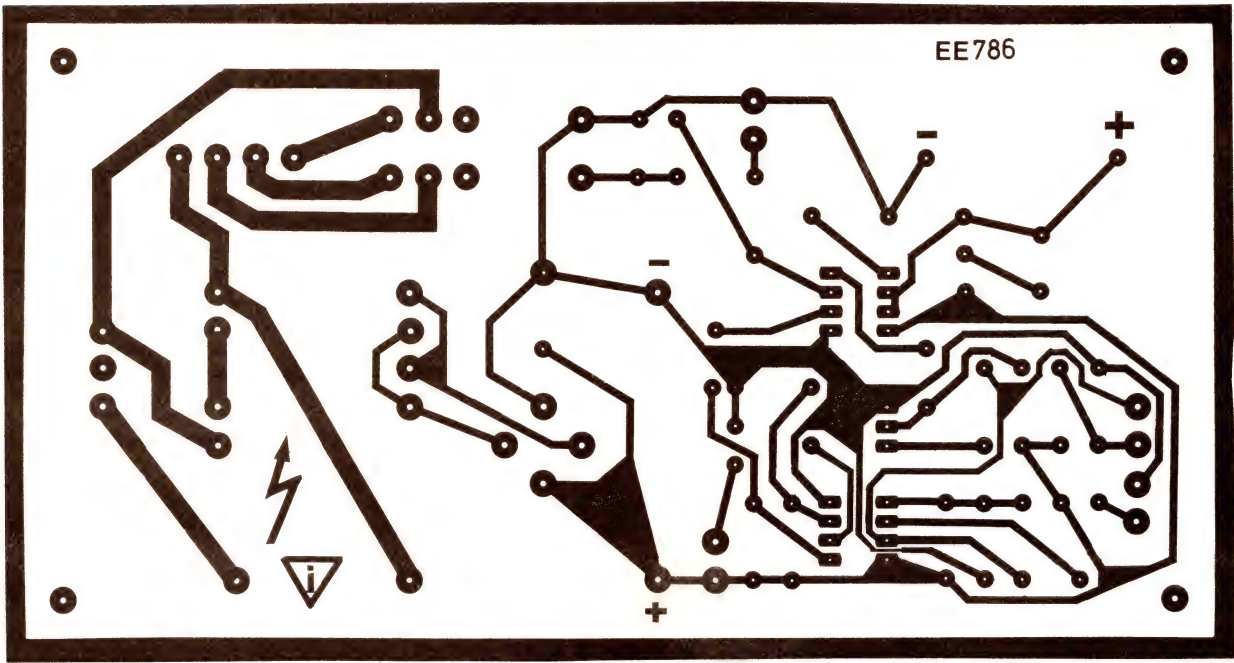


Fig. 4. Printed circuit board component layout and full size copper foil master pattern.

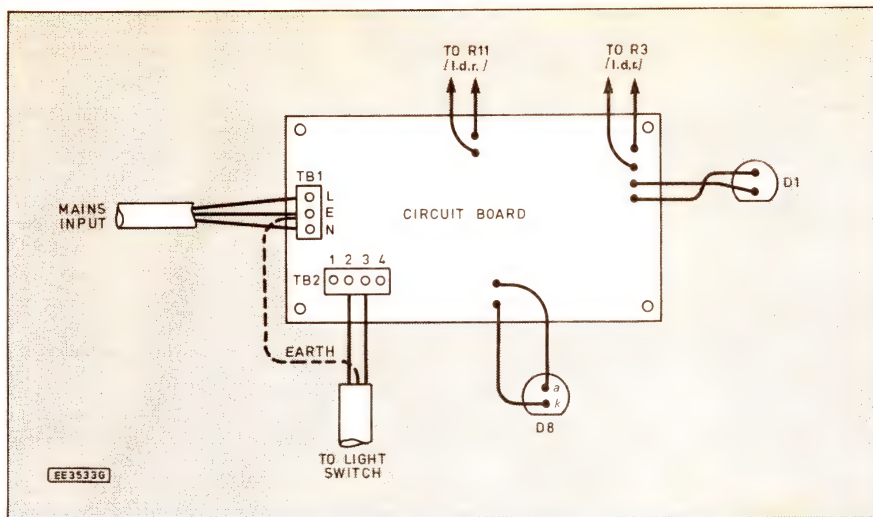


It should be noted that the p.c.b. is designed to a 0.1in. pitch throughout, and it is therefore very important to purchase a transformer of the same pitch (5.08mm), as well as general pin configuration, to fit correctly on the circuit board. Metric pitch (5.00mm) transformers will not fit snugly on the p.c.b. and should not be used.

After mounting all the components on the p.c.b., the board can be installed into the box. If a plastic housing is used, it is very important to mount the p.c.b. with *FULLY* insulated mounting pillars, such as p.v.c. stand-offs. These must be strong enough to carry the weight of the transformer and can be fixed into place with self-tapping screws at each end.

The flying leads for the l.d.r. photocells and light-emitting diodes were soldered directly to the p.c.b. as per Fig. 5, though the mains connections are taken to the screw terminals. At this stage, do not connect anything to the 4-way block, and do not connect the board to the mains supply.

On the prototype, l.d.r. R3 (Daylight detector) was mounted on a small tagstrip, with fixing lugs, and was located flush against the garage window; it was connected by a length of twin-core cable. The cable could be five metres long or more, if required.



available, then it is very easy to construct an "outdoor" unit which could be mounted say on a door frame or near the eaves (if any). The suggested outdoor unit is built into a small plastic housing with a clip-on lid – an Aspirin container, for example.

On the other hand, l.d.r. R11 must be mounted in the garage in a location where light from the car's headlamps will fall onto it. This photocell could be glued directly on a small plastic box as per the prototype, or indeed could be affixed to the box of the main unit itself if this is in a suitable position. Both photocells must be positioned where light from the electric light does not fall onto them to avoid feedback, and trial and error will determine the best location.

With assembly now complete, inspect the board for any errors or omissions. Pay special attention to the polarity of the bridge rectifier and smoothing capacitor C1. Insert the two integrated circuits into their sockets, right way round, if you have not already done so.

By far the best way of checking the unit before permanently installing it is to connect the board to a bench power supply if one is available. With the l.e.d.'s and photocells wired to the board (*but not the mains*), set presets VR1 and VR2 to midway, VR3 to nearly fully anti-clockwise, and clip a 12V d.c. supply across capacitor C1.

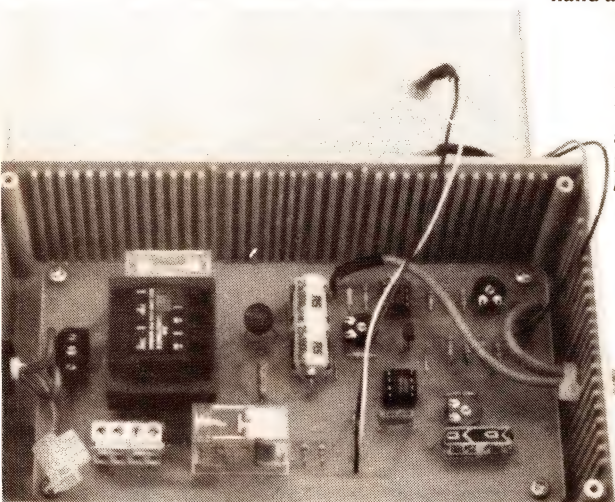
When the l.e.d. D1 turns green ("night-time"), temporarily exposing R11 to light will simulate car headlamps (adjust VR2 if necessary) and the relay should be heard to click into operation with the yellow l.e.d. D8 illuminating. After a period determined by preset VR3, the relay will switch out again.

If the board correctly operates as above, it can now be installed in the garage. Initially it would be better to run the board on the mains without connecting it to the light switch, so connect a 240V outlet via TB1. **It is extremely important to connect the Live, Neutral and Earth the right way round. Mains cables need to be secured with "P" clips or cable glands, for example, so that they cannot be pulled out.**

FINAL INSTALLATION

The link to the light switch can be effected with 1.00mm² flat twin core and earth (TC&E) electrical cable of the required length, with cables firmly fixed to the wall using cable clips. A modern light switch may already be earthed and an Earth connection can be linked to the earth (E) terminal of TBI, for continuity. Carefully bend the TC&E wiring to shape so as to avoid undue strain on the 4-way terminal block.

Finally, if the constructor is using the unit to install a light where one does not already exist, then a short link wire (made from **6A wire**) is fitted to join terminals TB2/1 and TB2/2 – see circuit diagram – and then an electric light can be wired in to terminals TB2/3 and TB2/4, again employing 1.00mm² flat twin core. If required, an Earth can be taken from TB1 (middle terminal) to earth any additional light fittings or switches which may be installed by the constructor. □



£1 BARGAIN PACKS

In fact, cheaper than £1 because if you buy 10 you can choose one other and receive it free.

5-13A SPURS provide a fused outlet to a ring main where devices such as a clock must not be switched off. Order ref. 2.

4-IN FLEX SWITCHES with neon on/off lights, saves leaving things switched on. Order ref. 7.

2-6V 1A MAINS TRANSFORMERS upright mounting with fixing clamps. Order ref. 9.

1-6 1/4" SPEAKER CABINET ideal for extensions, takes our 6 1/4" speaker. Order ref. 11.

12-30 WATT REED SWITCHES, it's surprising what you can make with these - burglar alarms, secret switches, relay, etc. Order ref. 13.

2-25 WATT LOUDSPEAKERS two unit crossovers. Order ref. 22.

2-NICAD CONSTANT CURRENT CHARGERS adapt to charge almost any nicad battery. Order ref. 30.

2-HUMIDITY SWITCHES, as the air becomes damper the membrane stretches and operates a microswitch. Order ref. 32.

5-13A ROCKER SWITCH three tags so on/off, or change over with centre off. Order ref. 42.

1-24HR TIME SWITCH, ex-Electricity Board, automatically adjust for lengthening and shortening day. Original cost £40 each. Order ref. 45.

1-MINI UNISELECTOR, one use is for an electric jigsaw puzzle, we give circuit diagram for this. One pulse into motor moves switch through one pole. Order ref. 56.

2-FLAT SOLENOIDS - you could make your multi-tester read AC amps with this. Order ref. 79.

1-SUCK OR BLOW OPERATED PRESSURE SWITCH, or it can be operated by any low pressure variation such as water level in water tanks. Order ref. 67.

1-MAINS OPERATED MOTORS with gearbox. Final speed 16 rpm, 2 watt rated. Order ref. 91.

1-6V 750mA POWER SUPPLY, nicely cased with mains input and 6V output leads. Order ref. 103A.

2-STRIPPER BOARD, each contains a 400V 2A bridge rectifier and 14 other diodes and rectifiers as well as dozens of condensers, etc. Order ref. 120.

10m TWIN SCREENED FLEX with white pvc cover. Order ref. 122.

12-VERY FINE DRILLS for pcb boards etc. Normal cost about 80p each. Order ref. 128.

2-PLASTIC BOXES approx 3in cube with square hole through top so ideal for interrupted beam switch etc. Order ref. 132.

5-MOTORS FOR MODEL AEROPLANES, spin to start so needs no switch. Order ref. 134.

6-MICROPHONE INSERTS - magnetic 400 ohm also act as speakers. Order ref. 139.

4-REED RELAY KITS, you get 16 reed switches and 4 coil sets with notes on making c/o relays and other gadgets. Order ref. 148.

6-SAFETY COVER for 13A sockets - prevent those inquisitive little fingers from getting nasty shocks. Order ref. 149.

6-Neon Indicators in panel mounting holders with lens. Order ref. 180.

1-IN FLEX SIMMERSTAT - keeps your soldering iron etc. always at the ready. Order ref. 196.

1-MAINS SOLENOID, very powerful as 1/2" pull or could push if modified. Order ref. 199.

10-KEYBOARD SWITCHES - made for computers but have many other applications. Order ref. 201.

1-ELECTRIC CLOCK, mains operated, put this in a box and you need never be late. Order ref. 211.

4-12V ALARMS, makes a noise about as loud as a car horn. All brand new. Order ref. 221.

2-6" X 4" SPEAKERS, 4 ohm made for Radiomobile so very good quality. Order ref. 242.

2-6" X 4" SPEAKERS, 16 ohm 5 watts so can be joined in parallel to make a high wattage column. Order ref. 243.

1-PANOSTAT, controls output of boiling ring from simmer up to boil. Order ref. 252.

50-LEADS with push-on 1/4" tags - a must for hook ups - mains connections etc. Order ref. 259.

2-OBLONG PUSH SWITCHES for bell or chimes, these can switch mains up to 5 amps so could be foot switch if fitted into pattress. Order ref. 263.

1-MINI 1 WATT AMP for record player attached to unit that will also change speed of record player motor. Order ref. 268.

3-MILD STEEL BOXES approx 3" x 3" x 1" deep - standard electrical. Order ref. 283.

50-MIXED SILICON DIODES. Order ref. 293.

1-6 DIGIT MAINS OPERATED COUNTER, standard size but counts in even numbers. Order ref. 28.

1-IN-FLIGHT STEREO UNIT, Has 2 most useful mini moving coil speakers. Ex BOAC. Order ref. 29.

2-6V OPERATED REED RELAYS, one normally on, other normally closed. Order ref. 48.

2-PLUG IN RELAYS with 3 changeover contacts. Coil operated by 12V DC or 24V AC. Order ref. 50.

1-CABINET LOCK with 2 keys. Order ref. 55.

4-DOLLS HOUSE SWITCHES or use them for any other low voltage application. Order ref. 57.

1-MAGNETIC BRAKE for stopping a motor or rotating tool. Order ref. 66.

1-TIMER REMINDER. Set it for anything up to 60 minutes. Order ref. 77.

1-SHADED POLE MAINS MOTOR. 1/4" stack so quite powerful. Order ref. 85.

2-5" ALUMINIUM FAN BLADES. Could be fitted to the above motor. Order ref. 86.

-BARGAINS GALORE-

OSCILLOSCOPE 301B developed for testing transmission lines, it makes and displays pulse echoes to find shorts and breaks in cable networks, this uses a 3" CRT to display the type of fault and a LCD to read out the distance from the fault. The instrument is powered by 12V or rechargeable nicads located in base, and it generates 1.5kV internally. It is housed in a high impact plastic case, size approx. 9 1/2" x 9 1/2" x 5" Ex British Telecom in very good condition and tested to be in good working order, £49.50 plus £5.00 insured delivery.

LITHIUM BATTERIES 3.5V penlight size, 2 mounted on p.c.b. with diodes, other bits. Lithium batteries as you may know are virtually everlasting (until they are put in circuit of course) so they are ideal for alarms and similar devices that do not draw current but do rely on it always being available. 4 panels that is 8 batteries altogether £2. Order ref. 2P258B.

POWER SUPPLY WITH EXTRAS output 12V 1A, mains input is fused and filtered and 12V output is voltage regulated, very well made on p.c.b., and also mounted on the board but easily removed are two 12V relays and a Piezosounder. Made for expensive equipment but never installed, price £3. Order ref. 3P80B.

12 VOLT 1.9 AMP-HOUR rechargeable battery by Jap YUASHA brand new, charged ready for use £6.50 each. Solar charger to house this and keep it ready £29.50.

100 WATT MAINS TRANSFORMERS all normal primaries: 20-0-20V 2 1/2A, 30V 3 1/2A, 40V 2 1/2A and 50V 2A secondaries all upright mounting, all £4 each, good quantities in stock.

COLOUR MONITORS 12" high resolution in black metal case with mains p.s.u. built in, unused, but line rejects so will require servicing, hence offered at the very low price of £49 plus £5 delivery.

PHILIPS 9" HIGH RESOLUTION MONITOR black and white in metal frame for easy mounting, brand new still in makers packing, offered at less than price of tube alone, only £15 plus £5 delivery - good discount for quantities.

16 CHARACTER 2 LINE DISPLAY screen size 85mm x 36mm, Alpha-numeric LCD dot matrix module with integral microprocessor made by Epson their ref 16027AR brand £8 each, 10 for £70, 100 for £500.

INSULATION TESTER WITH MULTIMETER internally generates voltages which enable you to read insulation directly in megohms. The multimeter has four ranges, AC/DC Volts, 3 ranges DC milliamps, 3 ranges resistance and 5 amp range. These instruments are EX British Telecom, but in very good condition, tested and gntd. OK, probably cost at least £50 each, yours for only £7.50 with leads, carrying case £2.00 extra.

BRUSHLESS D.C. 12V FAN tiny, only 60mm square, good air mover but causes no interference £8.00.

2MW LASER Helium Neon by PHILIPS, full spec, £30, power supply for this in kit form with case is £15.00, or in larger case to house tube as well £17.00. The larger unit, made up, tested and ready to use, complete with laser tube £69 plus £5 insured delivery.

MAINS 230V FAN best make "PAPST" 4 1/2" square, metal blades £8.

SOLAR CHARGER holds 4 AA nicads and recharges these in 8 hrs., in very neat plastic case £6.

SOLAR CELLS with terminals for joining in series for higher volts or parallel for extra current. 100mA £1, 400mA £2, 700mA £2.75, 1A £3.50.

SOLAR MOTORS 1 1/2-9V precision made to operate from low current solar cells £1.50, solar generator to drive this £7, has provision for battery back up when sun is not shining!

AIR SPACES TRIMMER CAPS 2-20pf ideal for precision tuning uhf circuits 25p each, 10 for £2, 100 for £15.

1KHz. TONE GENERATOR this is PP3 battery operated and has a 1KHz output that can be continuous or interrupted at a rate variable by a panel mounted control. Constructed on a pcb and front panel size approx 105mm x 50mm ex equipment but in as new condition £2 each.

MAINS ISOLATION TRANSFORMER stops you getting "to earth" shocks, 230V in and 230V out, 150 watt upright mounting £7.50.

MINI MONO AMP on pcb size 4" x 2" with front panel holding volume control and with spare hole for switch or tone control. Output is 4 watt into 4 ohm speaker using 12V or 1 watt into 8 ohm using 9V. Brand new and perfect only £1 each or 12 for £10.

5 RPM 60W MAINS DRIVEN MOTOR AND GEARBOX this has a 3" square mounting plate and is 4" deep. It is a shaded pole motor. Price £5.

POWER SUPPLY UNITS mains in, dc out, based 4.5V 100mA regulated £1, 6V 200mA regulated £1, 6V 700mA £1, 9V 500mA £2, 12V 500mA £2, 12V 2A £5, 24V 200mA £2.

TOROIDAL MAINS TRANSFORMER with twin outputs, 6.3V 2amps and 12V 1 amp, one use would be power supply, price £5.

AMSTRAD POWER UNIT 13.5V at 1.9A encased and with leads and output plug, normal mains input £5 each, 10 for £45.

AMSTRAD 3.5 FLOPPY DRIVE Reference FD9 brand new and perfect. £35.

ATARI 64XE COMPUTER at 65K this is quite powerful so suitable for home or business, unused and in perfect order but less PSU; only £19.50. Handbook £5 extra.

9" CATHODE RAY TUBE Philips M24/306W, which is not only high resolution but is also X-ray and implosion protected, regular price over £30, you can have them at £12 each. Tubes are guaranteed unused.

80 WATT MAINS TRANSFORMERS two available in good quality, both with normal primaries and upright mounting, one is 20V 4A the other 40V 2A only £3 each or 10 for £27 carriage paid.

PROJECT BOX size approx 8" x 4" x 4 1/2" metal, sprayed grey, louvred ends for ventilation otherwise undrilled made for GPO so best quality, only £3 each or 10 for £27.

12V SOLENOID has good 1/2" pull or could push if modified, size approx. 1 1/2" long by 1" square. £1 each or 10 for £9.

WATER VALVE 230V operated with hose connections, ideal for auto plant spray or would control air or gas into tanks etc, £1 each or 10 for £9.

HANG UP PHONE won't clutter up your desk or workbench, current model, has pushbutton dialling, last number recall, internal alarm etc., Ex B.T. in good condition and fully working ready to plug in, £5.

HIGH VOLTAGE CAPS if you use these ask for our 1-20 kV Capacitor list, we have over 1/4 million in stock and might save you a lot of money.

ELECTRONIC BUMP & GO SPACESHIP sound and impact controlled responds to claps and shouts and reverses or diverts should it hit anything! Kit with really detailed instructions, will make ideal present for budding young electrician. Should be able to assemble but you may have to help with the soldering of the components on the PCB. Complete kit £8.95.

500V BRIDGE MEGGER developed for G.P.O. technicians the Ohmter 18B is the modern equivalent of the bridge megger. 9V battery operated it incorporates a 500V generation for insulation testing and a null balance bridge for very accurate resistance measurement. Ex B.T. in quite good condition with data & tested. Yours for a fraction of original cost £45 + £5 insured delivery.

EXPERIMENTING WITH VALVES don't spend a fortune on a mains transformer we can supply one with standard mains input and secs. of 250-0-250V at 75mA and 6.3V at 3A, price £5.

15 WATT 8 OHM 8" SPEAKER & 3" TWEETER made for a discontinued high quality music centre, give real hi-fi. and for only £4 pair.

ULTRASONIC TRANSMITTER/RECEIVER with Piezo alarm, built into preformed case, is triggered by movement disturbing reflected signal, intended for burglar alarm, car alarm, etc. has many extras, time delay, auto reset, secret off device etc. A £40 instrument yours for £10.

MOVEMENT ALARM goes off with slightest touch, ideal to protect car, cycle, doorway, window, stairway, etc. etc. Complete with piezo shrieker, ready to use. Only £2 (PP3 battery not supplied).

STEREO HEADPHONE extra lightweight with plug £2 each or 10 pairs for £18.

B.T. TELEPHONE LEAD 3m long with a B.T. flat plug ideal to make extension for phone, Fax, etc. 50p each, £40 per 100, £300 per 1,000.

WATER PUMP very powerful and with twin outlets, mains operated, £10.

STUDIO 100 by Amstrad, the ultimate disco control panel, has four separately controlled and metered channels, twin cassettes, AM/FM radio, stereo audio amplifier, phone & C.D. inputs, etc. etc, regular price over £400 we have a few still in maker's packing, brand new and guaranteed, yours for £99.

ROTARY POSITION CONTROLLER for aerials, ventilators, dampers, or applications requiring 180 degrees clockwise and anti-clockwise movement. We have the Sauter MVE4 154 servo motor drive ref AR30W35 regular price over £70 brand new, £15 each.

12 VOLT 8 AMP MAINS TRANSFORMER £4. Waterproof metal box for same, £4.

110 WATT SWITCHMODE POWER SUPPLY 230V mains operated, outputs of 38V 2 1/2A and 5V 3A, we have a lot of these and need the space so you can have these at a fraction of their cost. Our price is £6.

10VA MAINS TRANSFORMERS all p.c.b. mounting, all £1 each, 10 for £9, 100 for £75, for output 12-0-12V order ref WA1, 20-0-20V order ref WA3, 18-0-18V not p.c.b. mounting but fully shrouded same price order ref WA4.

0-1mA FULL VISION PANEL METER 2 1/2" square, scaled 0-100 but scale easily removed for re-writing £1 each, 10 for £9, 100 for £75.

5 AMP PANEL METER 80 x 70mm beautiful instruments £5 each, order ref WA7.

VU METER illuminate this from behind becomes on/off indicator as well, 1 1/2" square 75p each, 10 for £6, 100 for £50.

EDGE-WISE PANEL METER ideal when short of panel space only 40 x 14mm, also have built-in f.s.d., 500µA f.s.d., scaled 0-5, £1 each, 10 for £9, 100 for £75.

VIBRATING REED FREQUENCY PANEL METER 4" square, 55-65Hz, only £9 each.

LOW PRICED FIELD TELEPHONES, Ex-GPO models, not quite so nice-looking but quite efficient, and have the big advantage that the ringing is done by means of a hand operated internal generator. This saves a lot of batteries. These 'phones' have the normal type of rotary dial built in and can still be connected into a normal B.T. system. Tested, guaranteed in good order, price only £9.50 each. Order ref 9P5.

HAND GENERATORS as fitted in the above field telephones, this hand generator is a permanent magnet type and has an AC output of approximately 50V depending on how quickly you wind it. If you want a higher voltage then simply connect the output to a transformer. We have a lot of 60 watt bulb quite successfully. The hand generator, complete with handle, £4. Order ref 4P51.

DRY BATTERIES CAN BE RECHARGED but not with a normal d.c. charger, it must be a periodic current reversal type. We can supply the kit, with data, £9. Order ref 9P10.

THE COMPUTER GRADE CAPACITOR ideal for low, high current experiments, 75p each or 10 for £6. Two types available, 15000µF 10V or 10000µF 15V.

HELP YOUR BOYS INTO ELECTRONICS let them learn by experimenting with our simple kits. See our latest newsletter which will be sent to you with any order or ask us for a copy.

SUPER MULTI-METER Ex British Telecom, this is a 19-range 20K ohm p.v. top grade instrument, covers AC & DC voltages, current and resistance, very good condition, fully working and complete with leads £9.50, leather carrying case £2 extra (batteries not included but readily available).

SOLAR ENERGY EDUCATIONAL KIT. An ideal present for electronics students. It shows how to make solar circuits and electrical circuits, how to increase the voltage or current, how to use solar power to work a radio, calculator, cassette player and to charge nicad batteries. The kit comprises 8 solar cells, one solar motor, fan blades to fit motor and metal frame to hold it to complete a free-standing electric fan. A really well written instruction manual makes this a lovely little present. Price £8. order ref 8P42B.

WANT TO KNOW HOW FAST IT'S TURNING? Made by the famous Muirhead Company, we have DC tachometer generators which have an output voltage depending upon its speed. At 1000rpm for instance, the output voltage is 3.

Ex-equipment, price only 2 for £1. Order ref 246.

BSR RECORD PLAYERS. Although records are fast being superseded by compact discs, you or yours may still have a collection of records that you wish to play from time to time and it would, therefore, be a good idea to buy a spare record player before they disappear from the market. We have some that were originally intended for quite expensive midi systems, have never been used, are complete except for styli, price only £5 each. Order ref 5P175.

BLOW HEATERS. We can supply tangential units, 2.5kW, which is approx. 9" long plus the motor. This can be operated at full heat, half heat or cold blow. Price of unit is £6, and we include a control switch and wiring diagram. Order ref 6P12. We also have 1kW blow heater, only 6" wide, so ideal where space is limited under a desk or similar, or can be made into a portable heater for defrosting pipes, etc. Complete little unit, although motorised, is virtually silent in operation. A shaded pole motor drives air from tangential fan through 1kW spiral element. There is also a cut-out to switch heat off should anything stop the fan from blowing. Regular price of this unit is around £20. Yours for £5 or 5 for £20. Order ref 5P23.

Prices include V.A.T. Send cheque/postal order or ring and quote credit card number. Add £3 post and packing. Orders over £25 post free, unless postage quoted separately.

M & B ELECTRICAL SUPPLIES LTD
12 Boundary Road, Hove, Sussex BN3 4EH
Telephone (0273) 430380
Fax (0273) 410142

INTERFACE

Robert Penfold



LAST month we looked at digital to analogue converters for PCs. This month we continue with the same subject, but concentrate on how to get the basic signal from the converter to do something useful. It should be pointed out that most of the information provided here is not specific to PCs, and applies equally to other computers that are equipped with an add-on digital to analogue converter.

STEPPING UP

Most practical applications for digital to analogue converters involve the control of much higher powers than the converter itself can handle. A typical application would be the control of a d.c. electric motor. This might only involve power levels of a few watts, but this is still well beyond the capabilities of normal digital to analogue converters. The ZN426E for instance, can provide an output of up to 2.55 volts and must feed into a high load impedance. A typical small d.c. motor requires something like 12 volts at 1 to 2 amps when running at full speed.

Obviously a large amount of amplification is needed to permit a d.c. motor to be controlled. However, only a modest amount of voltage gain is required. The maximum output voltage of the ZN426E is 2.55 volts, which requires a boost by a factor of just under five in order to permit a 12 volt motor to be driven properly.

The current amplification is a different matter though, and a massive amount of gain is needed in order to permit the fairly high output impedance of a digital to analogue converter to control loads which draw an amp or two of current.

AMPLIFIER

The circuit diagram for an amplifier that will permit a ZN426E converter to control a d.c. electric motor that draws up to

about 1A is shown in Fig. 1. As will be discussed in detail later, the circuit is easily modified to accommodate higher currents.

Operational amplifier IC1 is used in the non-inverting mode with its voltage gain set at 4.9 times by R1 and R2. With a 0 to 2.55 volt input this gives an output voltage range of 0 to 12.495 volts. It is advisable to use one per cent or two per cent resistors for R1 and R2. Any errors in the output voltage range should then be small enough to permit a maximum output potential of at least 12 volts to be achieved. Alternatively, R2 could be replaced with a 4k7 preset which would then be adjusted to give a maximum output potential of precisely 12 volts.

The current amplification is provided by TR2, which is a Darlington power device. This acts as an emitter follower buffer stage at the output of IC1, effectively enabling IC1 to provide output currents of an amp or two. R3, R5, and TR1 form a conventional current limiting circuit, and these prevent output currents of much over one amp from flowing.

The parallel resistance of R3 and R5 sets the maximum output current available from the circuit, and by using a lower resistance here it is possible to have higher output currents. For example, three one ohm resistors in parallel would permit currents of up to about 2A to be accommodated. I would not recommend trying to use this circuit for higher output currents.

The load resistor for TR2 is R4, and this ensures that the circuit functions properly with no load connected to the circuit. C1 enables the circuit to provide brief pulses at high currents if required, and D1 protects the circuit from any high reverse voltages generated by the coils in the motor.

I have given the supply potential of the circuit as 15 volts, but this is an absolute minimum value. Ideally it would never fall below about 16 to 17 volts. Note that the input voltage does not have to be well regulated or highly smoothed.

Note also that TR2 will generate a substantial amount of heat, particularly when the unit is used at about half to two thirds of full speed. It must therefore be fitted on a substantial heatsink. One having a rating of about four degrees Centigrade per watt or lower should suffice.

REVERSING DECISIONS

Many motor speed control applications also involve controlling the direction of the motor. The direction of an ordinary d.c. electric motor is governed by the polarity of the supply. There is more than one way of placing the supply polarity under computer control. One method is to have a circuit that can provide positive and negative output voltages, with a central 0 volt setting at a value of about 128.

Increasing the value above 128 would then give increasing speed in one direction, while decreasing values below 128 would give increasing speed in the opposite direction. A circuit based on the DAC0801 could handle this type of control (see last month's *Interface* article).

A problem with this method of speed control is that it is very wasteful. You have what are effectively separate supplies for forward and reverse operation, and to some extent separate control circuits as well. My preferred method is to simply have a relay with d.p.d.t. contacts to switch the polarity of the output. A suitable circuit is shown in Fig. 2.

With this method a latching digital output is needed to control the relay via a simple driver circuit (TR3 etc.). The relay's

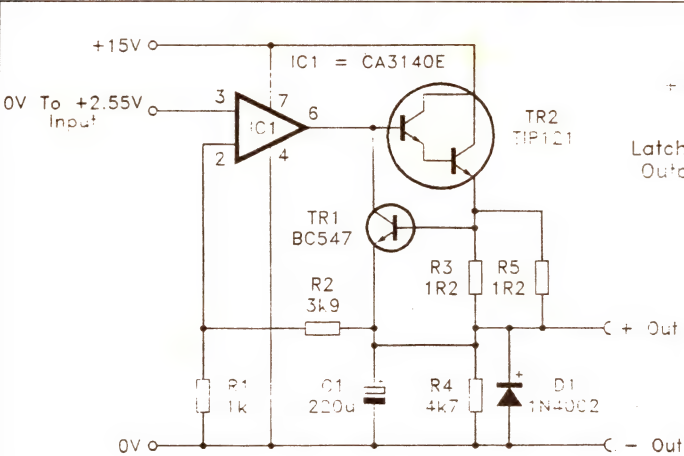


Fig. 1 (left). Circuit diagram of the d.c. motor interface.

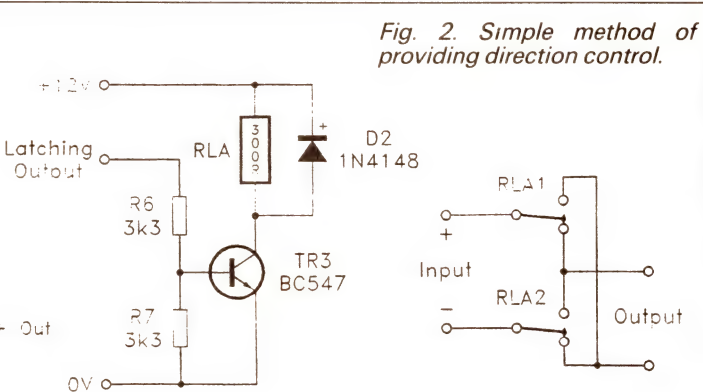


Fig. 2. Simple method of providing direction control.

coil resistance is given as 300 ohms in Fig. 2, but anything above about 200 ohms should be satisfactory. The PC's + 12 volt supply should be able to power one or two relay drivers without any problems.

Make sure that the relay contacts have adequate ratings. These contacts must be break before make types or they will short circuit the output of the controller each time they are activated! Fortunately, relay changeover contacts invariably seem to be of the break before make variety.

CONTROL

The digital output to control this port can be "borrowed" from the eight bit port driving the converter. For instance, input D0 of the converter can be connected to the 0 volt supply rail, and output D0 of the port can then be used to control the relay driver circuit. Odd numbers from 1 to 255 will then turn the motor in one direction, while even numbers from 2 to 254 will operate the motor in the other direction. A value of 0 switches off the motor, as usual.

A slight drawback of this method is that it gives only half as many motor speeds. In fairness, this is also true of any simple 8 bit method of speed control which also includes direction control. Being realistic about it, there are still over one hundred speeds in each direction. Even allowing for the fact that low values will probably fail to activate the motor and are of no practical use, this still gives a range of speeds that is more than adequate for most purposes. There is no obvious change in speed from one value to the next when using this method of control.

This type of controller is adequate for many applications, but it is less than ideal for something like a model train controller. This is due to the poor starting performance of simple controllers. Next month we will consider more sophisticated motor control using a pulsed type controller.

PORT CONTROL

Most current microprocessors are descended either from the 6800 or the 8080. The 6800 used memory-mapped I/O, and the 8080 a separate I/O space. The 80X86 processors used in PCs are descendants of the 8080, and thus use separate I/O addressing. The various processors in the 80X86 series can address differing amounts of memory, and memory addressing involves the rather complicated and infamous segmented addressing scheme.

Fortunately, the situation for I/O addressing is simpler, as all versions use straightforward 16-bit addressing. This means that there are a possible 65536 port addresses, but on PCs only 1024 are used, and add-on cards will always appear in the top 512 addresses. At the assembly-language level, the two instructions for I/O are simply IN and OUT. These have the syntax

```
IN accumulator, {portnumber|DX}
OUT {portnumber|DX}, accumulator
The number of the port can be either an
```

eight-bit immediate value or the DX register. Obviously, the DX register must be used for ports with a number higher than 255. For these instructions, the value to be sent to the port must be in the AX register for word values, or in AL for byte values, and these same instructions are used to receive values from ports.

In higher level languages, instructions with similar names may be found, though in some cases, where the language already uses IN as a keyword for something else, the input instruction usually becomes INP. For example, in Microsoft QBASIC, as supplied with MS-DOS 5, the instructions are:

```
x% = INP(port%)
OUT port%, data%
```

These instructions will also be found in many other PC dialects of BASIC.

C AND PASCAL

Strangely, the popular languages C and Pascal are less good in this respect than the higher-level language BASIC. Neither of these has input and output instructions as part of the basic language. This is largely because these languages are supposed to be portable across machines to some extent, and this tends to involve omitting features which are not portable! Support for I/O in the libraries depends on what the producer of the language supplies as extensions to the standard.

In the case of Microsoft C (and Quick C), four functions are provided. These are inp, inpw, outp, and outpw. The versions with the 'w' read or write a word value (16 bits), whereas those without read or write a byte value. The details are as follows.

```
Syntax: int inp( unsigned port );
        unsigned inpw( unsigned port );
        int outp( unsigned port, int
        databyte );
        unsigned outpw( unsigned port,
        unsigned dataword );
```

Returns: (inp) the byte read from the port.
 (inpw) the word read from the port.
 (outp) the byte output.
 (outpw) the word output.

Other compilers provide similar functions, though there may be detail differences. For example, the functions provided in the Zortech C++ compiler library are declared as follows.

```
Syntax: int inp(int port-address);
        int inpw(int port-address);
        void outp(int port-address, int
        value);
        void outpw(int port-address, int
        value);
```

Returns: (inp) the byte read from the port.
 (inpw) the word read from the port.

In Pascal, the effective standard in the PC world is really the Borland Turbo Pascal standard. Even Microsoft Quick Pascal follows this, except as regards object-oriented extensions. In Turbo Pascal, the ports are addressed as a pre-defined array, rather than through functions. This is consistent with the way in which direct access to memory is provided. As in C, byte or word access is possible. The details are as follows.

```
Syntax: Port[portnum]
        PortW[portnum]
```

As this is an array, it can appear on either side of an assignment statement, depending whether you want to write to or read from the port.

```
Examples: Read byte from port $61
          retval := Port[$61];
          Write word to port $B6
          PortW[$B6] := $1120;
```

CARE

When dealing with any of these port-addressing methods, care is obviously necessary. Some of the ports are used for specific purposes in the functioning of the computer, and writing to these could cause the machine to hang up, or, in some cases could result in loss of data. You should make sure you are always reading from or writing to safe addresses.

If you want to experiment, some suitable safe addresses are 61H and 42H. These are the ports which control the speaker on IBM PC's and compatibles. Bits 0 and 1 of port 61H turn the speaker on and off, and port 42H is a timer which controls the pitch. The higher the value written to this port, the lower the pitch.

Next time we will give some example programs in the languages mentioned here, demonstrating the basics of port addressing. We will be looking at some of the shareware languages available for the PC, with special regard as to how well they provide for interfacing to hardware.

EVERYDAY ELECTRONICS

NEWSAGENT ORDER FORM

Please reserve/deliver a copy of Everyday Electronics for me each month

Signed.....

Name and Address.....
(BLOCK CAPITALS PLEASE)

.....

Everyday Electronics is published on the first Friday of each month and distributed by Seymour.
Make sure of your copy of EE each month - cut out this form, fill it in and hand it to your newsagent.

Special Series

MAGNETIC RECORDING

Part 6: Tape Parameters and Tape Groups

VIVIAN CAPEL



Life today would be difficult to imagine without magnetic recording: No audio or video recorders; no computer disks; no payphone cards; no bank cash cards or magnetic security pass cards. In spite of its universal use, magnetic recording and the principles of magnetism are still little understood by most people.

PUBLISHED audio recording tape specifications can be rather perplexing for the ordinary user. Some makers provide quite a lot of technical data, which is commendable, but it often leaves the user confused as to which are the significant ones and what effect they have. We will take a look at those that are generally given and what they mean.

Reference level

Many of the specifications such as sensitivity, MOL, and frequency response are given in dB (decibels). These values are related to the figures shown on the recording level meters when you record.

The reference level above which you should not record with ordinary tape if distortion is to be kept low is 0dB. It represents a recording flux of 250 nano Webers/metre to which the meters are set during the tape deck's manufacture. A level of -3dB is thus 177nWb/m.

The reference level to which dolby noise reduction circuits must be set is 200nWb/m, which is just under -2dB. Both record and playback circuits must be set to this otherwise there will be mis-tracking.

Bias

An industry DIN standard bias setting has been established for each tape group, so the specification for a particular tape is usually given as a plus or minus dB value relative to this standard or to a specified reference tape.

In a previous article we saw that the recording bias in a recorder can be set to give either maximum frequency response or lowest distortion for a particular tape because the two do not coincide. Usually the machine is set for a compromise. As most machines have the bias preset, it cannot be adjusted by the user, so a tape must be selected that has a bias specification which corresponds to the recorder setting.

A tape with a value below that to which the recorder is set, will be overbiased and will have a reduced h.f. response, although it will also produce less distortion. One that has a higher value will have a better h.f. response, but it will also have a higher distortion level.

Usually, a tape is recommended for the tape deck or recorder by the maker because the machine's bias has been set for it. It

will therefore give optimum h.f. and distortion figures. However, any other make of tape will give comparable results providing it has the same bias specification.

Generally though, modern tapes are formulated to avoid sharp humps in their bias/distortion and bias/frequency response curves, so they are not all that critical. A small deviation from the set bias has little audible effect although it can be measured with test equipment. Greater deviations may be noticeable if the reproducing equipment is capable of resolving it.

Coercivity

Readers of the first article (Oct '91) in the series may remember that coercivity is the reverse magnetic field required to reduce to zero a material that has been magnetized to saturation. Think of it as being coerced to give up its magnetism when it doesn't want to! The unit of coercivity is the oersted or the kAmp/metre. To convert, 1 kA/m = 12.5 oersteds.

Applied to recording tape it indicates the force required to erase a previously recorded tape. It also indicates the tape's resistance to self-demagnetization or demagnetization from external fields. Recordings made on a high coercivity tape are likely to be more permanent and less vulnerable than those on tape with a lower coercivity.

Higher coercivity requires high recording and erase currents, so the recorder must be capable of supplying them. Metal tapes have high coercivity, and cannot be recorded on non-metallic machines. But providing the recorder is designed to record tapes in that particular group, it is unlikely that it will encounter a tape it cannot record.

Distortion

Nearly all of the distortion generated by recording on tape is *third harmonic*, so the quoted figure is usually for that. As we have seen, distortion varies with bias, so the figure is for the optimum bias level for lowest distortion. This means that if a compromise bias setting has been made between distortion and h.f. response, the distortion will be slightly higher than that quoted.

Some makers provide a graph showing the distortion at various bias levels. An

informed choice can then be made of bias level, if it is user variable. The increase in distortion may be so small at optimum h.f. setting that it may be considered undetectable and the bias set for maximum h.f. response.

Another factor affecting the distortion is the recording level: the higher it is, the greater distortion. The 0dB level is often used for measuring distortion, but -3dB or even -4dB is frequently preferred by tape makers as it produces a lower distortion figure - which looks better on paper!

Having said this though, the -3dB figure is probably the most realistic as the greater part of most recordings are around or below this point. Only on rare peaks should the level swing to 0dB.

Dynamic range

The term dynamic range is the difference between the largest and smallest recordable signals. It affects the *realism* of the reproduction because a wide range is needed to reproduce both the loudest and softest sounds made by a large orchestra. For speech and most non-musical sources, dynamic range is of less importance.

The loudest sounds that can be recorded are limited by the *saturation point* of the magnetic material. But before this, the *hysteresis loop* (see Oct '91) deviates from the straight part into a curve, thereby compressing and distorting the signal over this portion. Practically, then, it is the start of this curve where distortion increases rapidly, that sets the limit for the largest recordable signal.

In the opposite direction, the lowest signal is limited by the noise level. Noise was a problem with recording tape in the early days, which is why noise reduction circuits proliferated. There are three main causes of noise: *modulation noise*; *asperity noise*; and *non-uniform particle noise*.

With modulation noise, different numbers of magnetic particles are magnetized as the tape leaves the gap because of the changing signal level. As the distribution of particles in the binder cannot be exactly equal per unit of area, the result is unevenness in the recorded waveform.

This appears as noise which is greater for large signal excursions than for small ones. To some extent then it is masked by the large signals, but as the largest signals are usually bass notes, and the noise is

of higher frequency, masking is not total. However, it is less noticeable than other types of noise which are heard in quiet or silent passages.

Asperity (roughness or hardness of a surface) noise arises from unevenness of the coating. Displacements are thereby produced as the asperities lift the tape from the head. Random signal variations result causing amplitude modulation of the signal. The sidebands of this modulation are heard as noise.

Non-uniformity in the size and shape of the magnetic particles, in their crystalline structure and in their interaction with adjacent particles produces localised variations in remanance and coercivity. Thus each is left in a slightly different magnetic state irrespective of the applied signal waveform. The result is noise.

All these causes of noise have been reduced by developments and improved manufacturing techniques over the years until with present high quality tapes they have been reduced to levels that would have been a cause of wonderment a decade or so ago. Often now, the recorder's erase, bias and playback circuits produce much more noise than the tape.

This has produced a situation where noise reduction circuits are virtually redundant. Originally they were essential to combat the high noise levels then experienced, but there were always snags. Inevitably, any complex signal processing produces distortion, and to this was added "noise pumping", the audible variations of noise with signal level.

Circuits have to be carefully set up so that recording and playback sections exactly mirrored each other, and any mis-setting produced even more distortion. It is

with some relief then, that now the noise reduction circuits can be thrown out or left switched off.

Of course, tape noise has not disappeared altogether, and a tape that is grossly under-recorded will still sound noisy. So the need to maintain a good recording level with the peaks coming to just below 0dB remains. To be unobtrusive, noise should be at least 10dB below the level of the quietest sound. In practice then, the usable dynamic range is from 0dB down to 10dB above noise level.

The loudest volume generated by a large orchestra as heard from a good seat in a concert hall has been measured at 86dB, while the quietest was 45dB. The dynamic range was thus 41dB. A large choral work with full choir can generate up to 94dB so giving a range of 49dB. Compression is applied to broadcast music, so recordings made from the radio would have a smaller range than these.

Frequency Response

The quoted frequency response will not be the one you obtain. As we have seen, the response depends on the bias and also the head gap, so the type of machine will greatly affect results. In addition h.f. response depends on the recording level; it is reduced as the level increases due to the fringe field and other losses.

As a result, the response often quoted by the makers is that obtained at a level of -20dB. Now we can accept them giving us a distortion level specification taken at -3dB, but a -20dB level is well below average, and its use as a measuring standard is really rather naughty. The h.f. response you actually get will therefore be

well below the quoted figure. However, it can serve to compare the response of different tapes.

MOL

The term MOL has nothing to do with a gangster's girlfriend! It means Maximum Output Level, sometimes called MML, Maximum Modulation Level. It is the maximum level you can record for a given amount of distortion which is usually 3 per cent, but sometimes 5 per cent. The rating is in dB and two figures are often given, one for high and another for medium frequencies.

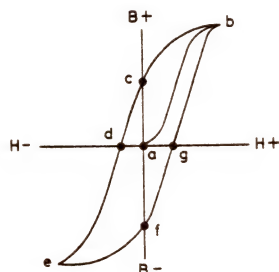
The high frequency is 10kHz at which the MOL is usually quoted for saturation point. This may seem unrealistic as the distortion at saturation is very high and no one records at that level. Actually though, harmonic distortion is low at high frequencies near the limit of the frequency range.

The reason is simple. Harmonic distortion consists of spurious harmonics at two, three, four times the fundamental frequency and so on. So at 10kHz, the second harmonic is at 20kHz and the third at 30kHz which is the principal one for tape recording. These are well outside the recordable limits so, at 10kHz, no harmonic distortion can be actually recorded.

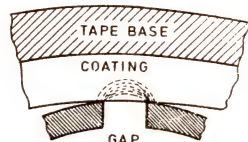
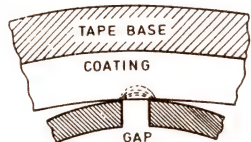
Print-through

Print-through is the transference of a recording to adjacent layers thereby producing echo or pre-echo. It is more likely to occur when a tape has been wound without playing or winding on for a long period. It could thus be a problem with archive material. The specification is given in dBs and is the ratio of the level of the original recording to that of the transferred one.

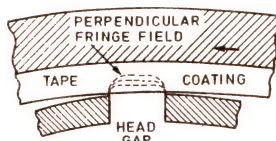
TECHNIQUES AND PROBLEMS OF MAGNETIC RECORDING



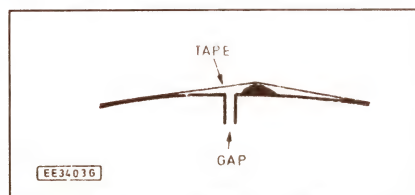
Hysteresis loop. After initial magnetization a-b, the flux falls from saturation when field is removed b-c, then requires a reverse field to restore it to zero, c-d; further applied reverse field builds up to saturation point e; then a removal causes drop e-f. A forward field now reduces the flux to zero, f-g; whereupon increased forward field raises the flux to forward saturation, g-b.



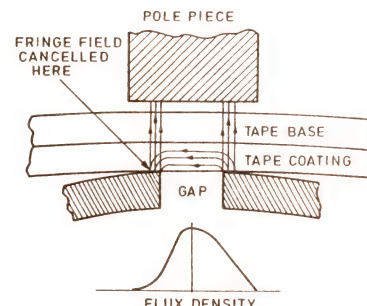
A wide recording head gap produces a field that penetrates deeper into the tape coating than a narrow one because the radius of the field is proportional to it.



The perpendicular field at the trailing edge tries to change the longitudinal magnetic orientation achieved in the gap. Short magnetic zones are more affected than long ones, so short-wavelength high-frequencies are partly erased while long-wavelengths are unaffected.



'Tenting' effect. A blob of dirt holds the tape off from the gap producing low-level recordings, and loss of field from short magnetic zones (high frequencies) during playback.



Crossfield bias. An auxiliary signal field established between the head and a pole piece behind the tape. The direction of the flux reinforces the head flux at the leading edge but cancels it at the trailing edge. This eliminates the perpendicular field and so permits higher frequencies to be recorded. The asymmetrical flux distortion across the gap is shown.

Early colbalt doped tapes were prone to it, but improved methods which give even distribution of the dopant, have largely overcome the problem. Magnetic particle size is a major factor, small particles being more easily magnetized. When particles were of random granular shape, print-through was common, but the needle-shaped or ellipsoid particles which are now generally used offer a much higher resistance to it, especially since bead milling has reduced the incidence of particle break-up in the milling process.

All told then, print-through is not a big problem and the ordinary user can ignore it, but archive tapes should be chosen to have a low specified print-through as they may have to lie for very long periods without playing. Even so, it is good practice for them to be re-spooled occasionally.

Remanence

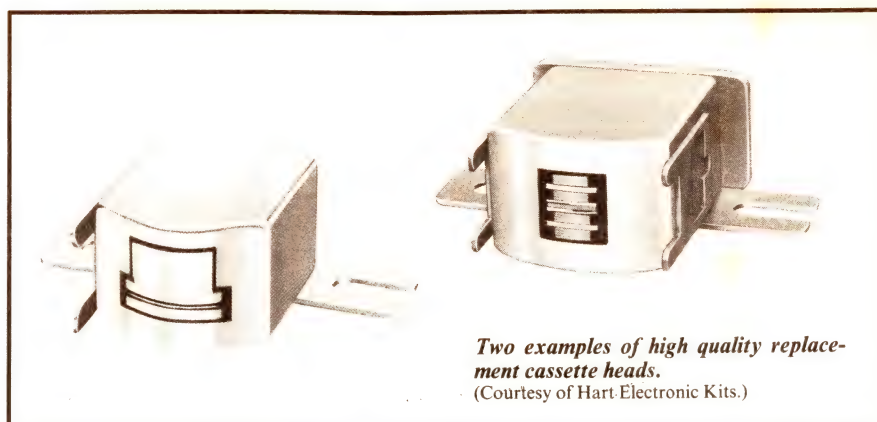
Remanence specifies the amount of magnetism remaining on the tape after the magnetizing force has been removed. It thus directly affects the sensitivity. The unit is the gauss or the milliTesla. (1 mT = 10 gauss.)

Sensitivity

Sensitivity figures stipulate the output at various frequencies that is obtained for a specified recording level which is generally -20dB. This is 25nWb/m, and the frequencies generally used are 315Hz, 3150Hz, 10kHz and 16kHz.

Usually, most tape users buy a tape that they have previously found to give good results on their recorder. This is not at all a bad criterion, in fact it is the best as it is the results that really matter.

A tape that gives excellent results on one machine may give poor results on another,



Two examples of high quality replacement cassette heads.

(Courtesy of Hart Electronic Kits.)

while a tape that seemed disappointing on the first recorder may sound well on the second. While there are good and bad tapes on the market, it is not always that one tape is better than another, but that the machine has been set up to suit that tape.

If then you find a tape that suits your machine, it is as well to stick to it, although sometimes the trial of another make can bring a pleasant surprise.

We will now deal with the four groups of tape and their subdivisions. It is a knowledge of these that really offers the best prospect of upgrading.

TAPE GROUPS

As we have just seen tape characteristics vary considerably according to the factors governing the magnetic properties of the coating. To produce a degree of uniformity enabling different brands to be used with not too great a difference in performance, coatings are classified into four

main groups, with the first in particular, having sub-divisions.

Group One - Ferric

Group one tape consists of ferric types having 120µs equalization. It is the most common group and a cassette can be assumed to be group one unless otherwise stated. Pre-recorded musicassettes are made on this type although usually to a special formulation.

There are three basic grades. The lowest appears under various descriptions including *standard*, *dynamic*, *ferric*, and *low-noise*. Within this grade though there can be considerable differences which can be loosely related to price.

Some cheap unknown brands sold on market stalls have low remanence which means that the resulting recording is of low volume when played back. Tape noise tends to be high, and as playback volume must be well advanced because of the low recorded level, the noise is further increased. Frequency response is also poor.

These tapes are probably satisfactory for audio note taking or dictation, but little else. Having said that, sometimes a cheap brand turns up that is surprisingly good although not in the same class as the reputable ones. The snag is that another sample of the same brand may be bad, so there is no consistency and it cannot be relied on.

Turning to the well-known reputable names such as Sony (my personal favourite), excellent results can be obtained from even the standard grade. The fact is that over the years the performance of most reputable brands have improved so much that now better results can be obtained from their lowest grade than were available from their top grades of a decade or so ago.

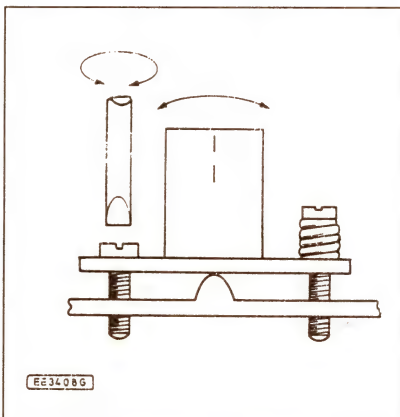
One visible improvement is in the almost mirror-like smoothness of the playing surface compared to the matt finish of a few years ago. Apart from reduced head-wear, this produces less flutter (the distortion caused by snatch-and-drag effects of the tape sticking to the head or pressure pad), a generally smoother flow, and minimal asperity noise.

Another area of improvement is in the mechanics of the cassette, which is noticeable during fast winding. Nowadays this is accomplished silently and smoothly, but at one time and indeed still is with the cheapy cassettes, was carried out with much noise, rattling, and slowing down.

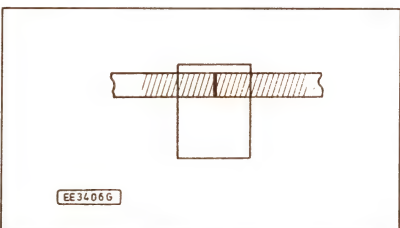
This improvement reduces the possibility of wow, the short-term cyclic speed variations at one time common, but now rarely heard. Also it eliminates long-term speed changes, with the tape slowing down towards the end when the take-up spool is nearly full.

It is certainly a waste of money to use a

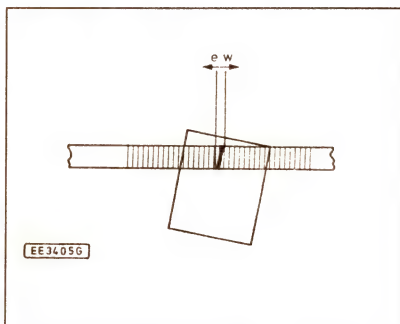
TAPE HEAD ALIGNMENT



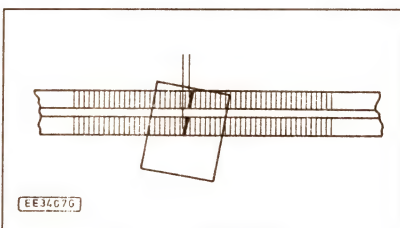
Azimuth is adjusted by rocking the head over a central pivot against the tension of a spring.



A tape recorded with an incorrect azimuth head has slanting magnetic zones and so results in high frequency loss when played with a head that is correct. There is no loss when played with the same head that recorded it.



Incorrect azimuth. The gap of the tilted head spans more than one vertical recorded zone thereby increasing its effective width (e.w.), so reducing resolution and losing high frequencies.



Playback with a stereo head of incorrect azimuth not only suffers loss of h.f., but has one channel lagging in time behind the other, so producing phase errors between channels and thereby impaired stereo.

higher grade in a portable tape recorder, car player, or average music centre. The standard grade of a good brand is more than adequate.

Though characteristics vary between makes, typical parameters for this grade are: coercivity, 380 oersteds; remanence, 140mT.

Microferric

The next grade in group one is often termed *microferric*, because it uses smaller more densely packed particles. Coercivity is the same as for the standard grade, but remanence is higher at around 160mT. This increases sensitivity by about 1dB over most of the curve, rising to over 2dB at the h.f. end. MOL (maximum output level) is also some 2dB higher.

Though technically better, there is little audible difference between this grade and the standard. The slight increase in sensitivity means a slightly lower playback volume setting is required. There is marginally less noise although in most cases this will not be noticed except at high volume levels.

One factor to note is that "print-through" tends to be worse by some 3dB to 6dB than for standard tapes. This grade should not therefore be used for archive recordings or any that will be dormant for long periods.

High Energy

The top grade in group one is frequently described as the *high energy* type. These usually have some additive such as cobalt to the coating. The coating is not heavily doped for this group as it would then have a high coercivity, requiring higher recording, bias, and erase current levels, as well as different equalizing characteristics. It would then not be compatible with other group one tapes.

Actual coercivity is about the same as for the lower grades, and the remanence is around 175mT. Sensitivity is some 2dB greater than standard tape, rising to 3dB at the h.f. end. MOL is about 4dB higher.

Noise is about the same as for the microferric grade, but the higher MOL gives a better signal/noise ratio. The greatest benefit from these improvements will be obtained when used on hi-fi systems at high volume levels.

Group Two - Chromium Dioxide

Group two originally described CrO_2 (chromium dioxide) coatings. While magnetically little different from gamma ferric oxide, a form having tetragonal lattice was produced using a hydrothermal process. This gave particles of more uniform shape which resulted in a superior h.f. response.

Consequently, CrO_2 tape needs less h.f. equalizing boost on playback than group one, namely 70µS, and it is applied higher up the frequency range, at 2.2kHz instead of 1.2kHz. Thus noise is also reduced, but some 3dB extra recording level is required.

With early chrome tape low-frequency response was poor, but the principal objection was that of high head wear. This was strenuously denied by one of the main manufacturers, BASF, and improvements on both counts were made. However, the mud stuck, and chrome fell from favour.

Its demise was hastened by the appearance of ferric tapes with a higher cobalt doping than used for the high energy

group one tapes. These have a similar coercivity to chrome of around 650 oersteds, and the same equalizing characteristics. They are intended for use with the recorder set to the "chrome" position, and give similar results but without the previously mentioned drawbacks of chrome.

The noise level of group two tapes is around 3dB - 5dB less than group one, this mainly being due to the smaller amount of treble boost, but this is partly offset by the lower MOL which is some 2dB down on comparable group one formulations.

Early cobalt doped tapes suffered from print-through due to uneven distribution of the dopant. The use of epitaxial oxides in which the cobalt is diffused into the surface area of the oxide particles seems to have improved matters. However, the possibility should be kept in mind when choosing tapes for archive purposes.

Group Three - Ferrochrome

Ferrochrome (group three) has virtually disappeared. It consisted of tape having a ferrochrome coating, that is a dual layer of ferric particles topped by one of chromium dioxide.

The purpose was to overcome the poor low-frequency performance of chrome. Long low-frequency magnetizing flux lines penetrate further into the tape coating than short high-frequency flux ones. Thus the low frequencies were recorded by the deeper ferric layer as with normal tape, while the h.f. was recorded on the top chrome layer.

The result was a tape giving the best of both worlds, but the abrasiveness of the upper chrome layer remained to accelerate head wear. With the disappearance of chrome tape and the dominance of group two with cobalt, the necessity for double layers has disappeared.

Group Four - Metal

Pure metal tape forms group four. It must be virtually the ultimate in tape coatings and with it, it seems that magnetic recording has gone full circle.

In the original wire recorders, the recording was made on steel wire which was stored on one reel and paid out to another. The transport mechanism not only had to

drive the reels, and move the wire through a notch in the record head, but also layer it neatly up and down the take-up reel.

The wire tended to be springy and if any slipped off the reel, it was almost impossible to disentangle and wind it back on by hand. There was no question of editing by cutting and inserting as can be done so easily with tape. It was also heavy.

Although greatly superior to the tape then available as a recording medium, wire lost out to it mainly because of inconvenience of handling and cost. Just as well it did, because as we have seen, tape has since steadily progressed to be the highly developed and effective medium it now is, and we are virtually back to the ultimate medium magnetically, with metal tape.

As to the obvious question as to why hasn't it been done before, the tiny particles oxidize almost immediately on exposure to air, sometimes explosively. So every one must be coated to protect it.

Typical characteristics of metal tape are: coercivity, 1100 oersteds; remanence 330mT. An equalization of 70µS, the same as group two is used. The h.f. MOL is some 4dB - 10dB higher than the highest non-metal tape and there is a better balance between the low and high frequencies.

Bias some 3dB - 6dB higher than group two is required and also higher erase currents are required to completely wipe the tape. Thus it can be seen that they cannot be successfully used on any machine not designed for them.

They are also rather expensive, and heavy. So in view of the excellent results obtained with the other groups, it is questionable whether the technical improvement of metal tape is really worth it at present, other than for special applications such as video camcorder tape.

Some metal tapes have been produced to work in the group two category. These have lower remanence and coercivity than group four metal, but have a higher MOL than non-metal group two types. Thus they afford some of the advantages of metal tape to users of decks without the metal facility.

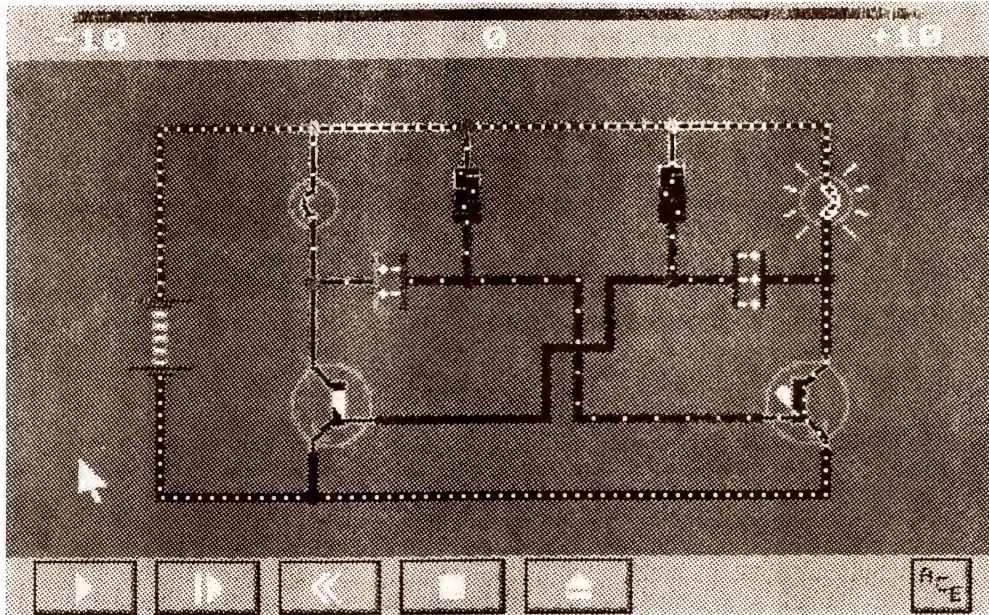
Over this series on *Magnetic Recording* we have explored a considerable area from basic magnetic theory to modern recording tape manufacture and its characteristics. It is hoped that readers who have followed it will not only have found it interesting but that it has enhanced their practical knowledge of recording tape and all things magnetic. □

The next step - the Philips Digital Compact Cassette (DCC).



ANIMATED CIRCUITS FOR ELETRONICS

Mike Tooley emerges briefly from the classroom to investigate a novel software package which uses computer animation to illustrate the operation of a variety of common electronic circuits.



The astable multivibrator simulation. The dots show the magnitude and flow of current while the colour of each part of the circuit indicates voltage potential.

SIX months, or so, ago I spent some considerable time explaining (in great detail) the operation of an astable multivibrator to a group of second year BTEC students. The point which several students found most difficult to comprehend was the fact that the base voltage is driven negative for part of the time. After all, how was it possible to have a negative voltage at the base of the transistor when the circuit was only supplied with a positive voltage?

After much debate and several hastily drawn circuits showing the path of current and magnitude of voltage within the circuit at various points in the cycle, I seemed to have all but the most doubting (and, as luck would have it, also the most vociferous) members of the class convinced.

At that point, I decided to press home my advantage and enlist the services of some visual aids. After a quick dash down to the lab two floors below, I was able to obtain the appropriate circuit board, power supply and oscilloscope.

Some fifteen or twenty minutes later, after battling with a mains lead that was too short and a 'scope that refused to trigger, I had very nearly convinced everyone in the group when it became clear that, in the students' minds, the need for a coffee

break far exceeded the need to understand this particular electronic puzzle. Upon this realisation, I gave in gracefully (if a little grudgingly) and returned to my office to lick my wounds and generally feel sorry for myself!

More recently, with the arrival of Animated Circuits for Education, I have discovered the ideal solution to this and similar problems. After all, what could be better than an animated circuit diagram which uses colour and motion to bring a circuit diagram to life?

Animated circuits

Animated Circuits for Education (ACE) is a completely new concept in the teaching of electricity and electronics. It combines simulation with animation to produce animated circuit diagrams. Colour shows voltage whilst dot motion shows current flow. The result is an easily comprehensible view of circuit operation.

What makes this even more exciting in comparison with conventional visual aids based on transparencies, 35mm slides, film and video is that the ACE software package is fully interactive. The user can operate the switches and adjust the variable potentiometers by simply pointing the mouse and clicking.

Animated Circuits includes 78 basic circuits. Topics covered include conductors and insulators, series and parallel circuits, measuring voltage current and resistance, fuses, variable resistors and potentiometers, current-voltage characteristics, internal resistance, capacitors, diodes and rectification, and basic transistor circuits.

Further circuit packs are currently under development and Ace Technologies can also develop sets of circuits to individual requirements for those who may find the 78 basic circuits insufficient for their needs.

Hardware requirements

It has to be stated at the outset that Animated Circuits for Electronics requires some reasonably powerful hardware. Indeed, equipment to this specification may well not be available in every classroom or laboratory!

As a minimum, Animated Circuits requires an IBM PC compatible with an 80286, 80386 or 80486 CPU and a minimum of 640Kbytes of RAM. The system should support VGA graphics and have a hard disk with at least 3MB of free space. The system must also have a Microsoft compatible mouse, appropriate MOUSE.COM software driver and a colour VGA (or SVGA) monitor.

Unfortunately (and despite the fact that competition is very rapidly forcing the price of 386 and 486 based systems down) someone investing in a system with this sort of specification would receive very little change from £1000 (even with educational discount). It must be evident that many schools and colleges have older equipment (XT and AT compatibles) and these will not run the Animated Circuits package unless they are suitably upgraded.

Installation

I must confess to having a little difficulty with the installation routine. Indeed, I failed at the very first hurdle as the large hard disk fitted to my 80386SX system just didn't have the space required to accommodate the programme (it always pays to read the manual **first**). After hastily pruning some 3MByte of unwanted .BAK files I was back in business and more than able to make up for my false start.

The next problem arose when I decided to delete the installed program and files and transfer the software to a newly acquired 486 machine. Once again I neglected to read the manual and, as a consequence, immediately fell foul of the copy protection mechanism (this requires that the installed software is properly removed and not simply deleted).

Copy protection

Animated Circuits is copy protected such that it is not possible to install the software on more than one machine. To quote the manual: "You have bought a licence to use the software on a single machine; you do not own the software."

When the time comes to transfer the package to another microcomputer, it must be removed using the REMOVE utility

straightforward. The mouse and VCR-style controls make it a dream to use (anyone who has used the popular Superbase database package will be familiar with this notion).

After selecting the required circuit from an initial menu screen, the circuit is displayed in large scale on the screen complete with a coloured voltage scale (calibrated over the range $-10V$ to $+10V$) at the top and a strip of VCR-style controls along the bottom edge of the screen.

Where more positive potentials exist, the respective conductors are coloured red. Where more negative potentials are present, these are indicated in green. The colour transition between negative and positive is reasonably gradual and it is easy to identify points in a circuit where the voltage is subject to change and roughly by how much.

Current flow is indicated by moving dots. It should be noted that these dots indicate the conventional flow of current and not the flow of electrons. The magnitude of the current is indicated by the relative density of the dots (more dots per unit length indicates greater current). The direction and magnitude of current flow is thus easy to ascertain.

The simulation includes several very nice touches which indicate that the developers know what they are doing. Magnetic fields build up slowly, fuses take time to rupture, positive charge carriers "trickle" through resistors impeded by a series of internal baffles, voltmeter needles respond to minor fluctuations in voltage, transistors are shown with internal valves opening and shutting according to the applied base current.

All of this is very graphic and accurate. Indeed, I could only find two tiny flaws in

tal principles of oscillation in minutes rather than hours. Well done ACE Technologies!

In the classroom

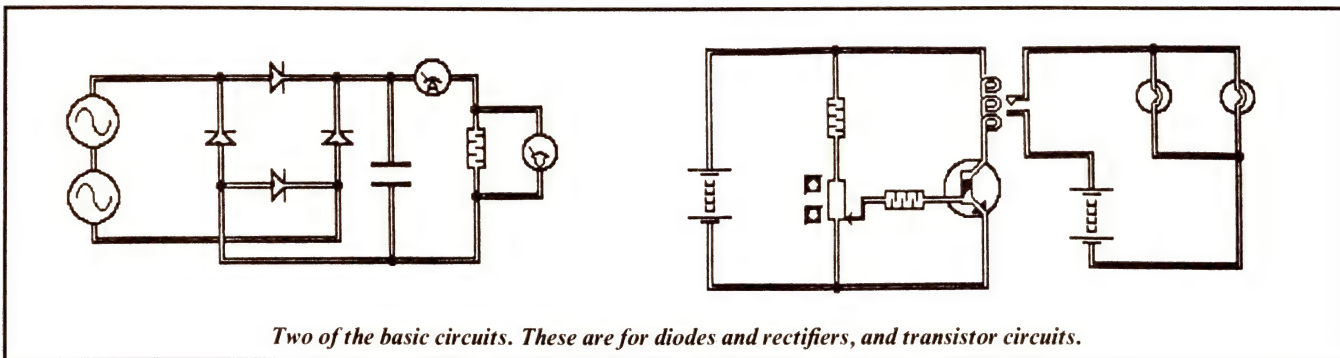
Whilst the software was in my possession, I took the opportunity to show Animated Circuits for Electronics to several colleagues and also to a number of students. The general consensus of opinion was that the package could be extremely useful though several of the teachers indicated that they would still be reluctant to abandon their handouts and overhead transparencies in favour of "mere" animated software.

Most people felt that the package would be more useful when used by an individual than when used as a class teaching aid. Indeed, this is probably where Animated Circuits would be at its best rather than as a replacement for conventional classroom visual aids. With this in mind, it should be of obvious benefit to the independent learner and could usefully form part of a "distance learning" or "open learning" package.

In conclusion

It really is very hard to find any fault with this package; it is quite unique and does exactly what it claims to do and in an exemplary fashion. My only criticism is that it could benefit from a facility for allowing the more adventurous user to animate his or her own circuit designs. Indeed, having used Animated Circuits for some time and after having exhausted the circuits built into the package, I began to hanker for some means of testing out my own circuits.

Fortunately, this is not quite so far-fetched as it might sound as the netlist for each circuit takes the form of a straightfor-



program which restores a copy protection token on the original master disk. Failure to observe this requirement (i.e. to restore the token) renders the master disk unusable - **you have been warned!**

It is not clear whether ACE Technologies would grant a site licence so that the software could be used on several machines at a particular location. In larger educational establishments this could be worth thinking about.

In use

I put the ACE package to the test over a period of about six weeks. It took next to no time to get to grips with the package and its highly intuitive user interface proved to be exceptionally

the operation of the simulated circuits (in one case a forward biased diode appeared to have a considerable voltage developed across it, whilst in the other an ammeter needle did not respond to the peak of current which occurs when a reservoir capacitor is "topped up" by a full-wave rectifier).

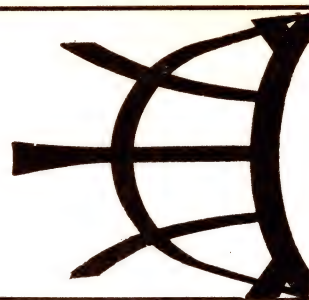
It is perhaps worth mentioning the simulations which I felt were quite outstanding in getting over some difficult to grasp concepts. One of these was none other than the dreaded astable multivibrator mentioned earlier. The other was an L-C tuned circuit which very effectively showed the way in which energy is transferred alternately between the two components with current oscillating and gradually decaying. This simulation could drive home the fundamen-

ward ASCII file. Having made this discovery, I must confess that I couldn't resist the temptation to "have a go"! As an experiment, I tried editing one of the netlist files in order to substitute some of my own circuitry. After one or two false starts and much to my delight, this worked well and I was duly rewarded with a fully animated version of my creation. Ace Technologies are apparently giving this some consideration and it is possible that such a facility may be incorporated into a future version of the software.

Animated Circuits for Electronics is available from Latcenter Electronics, 14 Mariner's Drive, Bradford, BD9 4JT. Tel: 0274 542868. Fax: 0274 481078. The package costs £199 plus VAT.

REPORTING AMATEUR RADIO

Tony Smith G4FAI



LISTENING ON VHF

I have previously mentioned that by using a 2m converter it is possible to listen to amateur v.h.f. transmissions on an h.f. receiver. Such a converter can be made as a home construction project or purchased commercially.

The converter has three sections, a tuned radio frequency amplifier covering 144MHz to 146MHz; a crystal oscillator providing a signal at 116MHz; and a mixer stage which combines an incoming signal at v.h.f., for example 145MHz, with the oscillator's signal at 116MHz, to produce an output at the difference frequency of 29MHz.

This output is fed to the antenna socket of an h.f. receiver tuned to 29MHz to receive the 145MHz signal. The amateur two metre band of 144-146MHz can then be tuned over the 28-30MHz range of the receiver.

A shortwave receiver which covers 28-30MHz, especially one with an s.s.b. facility, should receive many of the transmissions available quite satisfactorily, but a purpose built communications receiver would obviously be better for serious listening.

A directional multi-element antenna as high as possible is needed if distant signals are to be received. Again this can be home-made or purchased commercially.

There also needs to be some means of rotating the antenna. Commercial electrically powered rotators are available but sometimes it is possible to devise a means to turn the antenna by hand.

LOFT ANTENNAS

The width of an antenna for 2m is relatively small. A basic dipole is 1m wide, and if a quad antenna is used the square section is only 50cm across. Accordingly, a rotatable loft installation is often feasible, especially in a tall house or one located on high ground. For local signals a simple omni-directional vertical antenna will usually suffice.

The setup can be tested by tuning to a continuously transmitting beacon, such as GB3VHF at Wrotham on 144.925MHz, which should appear on the h.f. receiver as 28.925MHz. The transmissions are in Morse but all it sends is its callsign followed by a continuous tone for a short period sufficient to tune in properly for frequency checking.

Preferably, all signals heard should be recorded in a logbook. It will be noted that signals from a distant beacon vary in strength from time to time, and if the receiver has a signal strength meter (S-meter) it will be possible to record the strength of the signals on a scale ranging from one to nine, with the variations noted representing changes in propagation conditions.

Various modes can be heard on the band, including f.m. (frequency modulation), s.s.b. (single sideband), and c.w.

(Morse), plus various strange noises representing amateur T.V., fax, r.t.t.y., AMTOR, packet, and so on. Local, and not so local, amateurs will be heard working through repeaters on fixed frequencies, and other contacts will be heard in particular segments of the band reserved by gentleman's agreement (the "bandplan" - see Table 1) for particular modes.

VARIED ACTIVITIES

Although v.h.f. is conventionally considered to provide "line of sight" communications, stations will sometimes be heard many hundreds of miles away. These "lift" conditions create extra activity and excitement on the band and are caused by various factors which I will return to in a later column.

Other activities or events to be heard from time to time include satellite communications, moonbounce, auroral and meteor scatter propagation, RAYNET emergency communications, contests, news bulletins, and "nets" of clubs, etc, gathering together for regular "meetings on the air".

Of course these notes can only touch briefly on what, for some operators, is an all-absorbing branch of amateur radio. Last October I reviewed Ian Poole's book *An Introduction to VHF/UHF for Radio Amateurs* (available from the *EE Direct Book Service*), and this continues to be one of the best introductions to the subject for beginners.

CABLE PROBLEMS

Many holes and trenches appeared recently in the roads of my locality, causing much inconvenience to both residents and passing traffic. Trenches were then cut through the pavements up to the boundary line of every dwelling. We were asked to be tolerant of the inconvenience because it was all for our own good. Cable TV had come to town!

What has this to do with amateur radio? Hopefully, nothing, but there have been problems elsewhere. In some countries the signals passing through the cables are on frequencies allocated exclusively for amateur radio use. The cable TV operators claim that their

system is totally shielded so that cable signals cannot be picked up by amateur radio receivers and, conversely, amateur signals cannot be picked up by their cables and superimposed on their TV programmes.

Unfortunately, low quality cables and coaxial connectors have sometimes been used for the lines branching off to consumers and these have not always provided the required level of protection. The result has been interference both ways even when the amateur stations concerned have been operating perfectly legally and correctly within the regulations.

I wondered why we were having this flurry of activity when I read some time ago, in the *W5YI Report*, that in the States things did not look good for the future of cable thanks to the advent of new systems such as "wireless cable". This apparently broadcasts cable programming from a microwave tower to housetop antennas without the need to dig up entire localities and run cables into individual houses.

MORE NOVICES

In the September 1991 Novice Radio Amateur's Examination, set by the City & Guilds of London Institute, 151 out of 186 candidates were successful, representing a pass rate of 80.3 per cent. For those interested in this new route into amateur radio, a free Beginner's Pack, giving full details, is obtainable from the Radio Society of Great Britain, Lambda House, Cranborne Road, Potters bar EN6 3JE.

WELL DONE COMET!

I reported recently that a reader was having difficulty in getting his Sangean ATS 803A world band receiver repaired by Comet Group PLC as spares were running out for this discontinued model. As a result of the enquiries made by this column on our reader's behalf, I am happy to report that Comet have come up trumps after all. They have located the necessary components and repaired the set, apparently free of charge, even providing a full complement of batteries. Result, one very satisfied EE reader!

Table 1: 2 Metre Bandplan

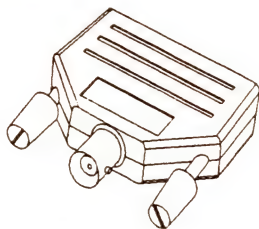
144.000MHz	-	144.150MHz	c.w. only
144.000	-	144.025	moonbounce
144.100			meteor scatter (c.w.)
144.150	-	144.500	s.s.b. and c.w.
144.400			meteor scatter (s.s.b.)
144.500	-	144.845	all modes
144.500			slow scan TV calling frequency
144.600			RTTY
144.675			data modes calling frequency
144.700			fax calling frequency
144.750			amateur TV calling and talkback
144.845	-	144.990	beacons
145.000	-	145.800	f.m. simplex and repeaters
145.800	-	146.000	satellites

PICO ADC-10

8-bit Analog to Digital Converter

for IBM PCs and compatibles

- 10-25kHz typical sampling speed
- 0-5v input range



- Plugs directly into parallel printer port
- Requires no external power
- Requires no expansion slots
- BNC input connector

Supplied with Oscilloscope & Voltmeter Software plus Turbo C & Turbo Pascal drivers.



£49.00 + VAT
(including p+p)



Pico Technology Limited

Broadway House, 149-151 St. Neots Road, Hardwick, Cambridge CB3 7QJ
Tel. 0954 211880



Happy Memories

4116	150ns pulls	1.00	256x9	SIMM 80ns	11.50
4164	100ns	1.45	256x9	SIPP 80ns	12.00
41256	80ns	1.65	6264	100ns LP	1.95
41464	80ns	2.25	62256	100ns LP	2.95
414256	80ns	3.95	2764	250ns	1.85
411000	80ns	3.95	27128	250ns	2.25
4Megx9	SIMM 80ns	120.00	27256	250ns	2.45
1Megx9	SIMM 80ns	32.50	27C256	250ns	2.45
1Megx9	SIPP 80ns	33.50	27512	250ns	3.45
			27C512	250ns	3.75

Motherboards

80286	Upto 4Mb RAM EMS on board	
12MHz	£55	16MHz £72
20MHz	£89	
80386SX	20MHz	£155
25MHz	£169	
80386DX	25MHz Cache	£275
80386DX	33MHz Cache	£335
80486SX	20MHz	£420
80486	33MHz Cache	£595

Diskdrives

5 1/4"	1.2Mb Floppy	£43
3 1/2"	1.44Mb Floppy	£36
5 1/4"	Frame for floppy	£5
43Mb	25Ms 3 1/2" IDE	£139
85Mb	19Ms 3 1/2" IDE	£215
104Mb	19Ms 3 1/2" IDE	£240
180Mb	19Ms 3 1/2" IDE	£375

Plug-ins

120Mb	Internal Tape Streamer	£215
102	Key Tactile Keyboard	£27.50
Serial	Mouse 9/25 & software	£13.95

Video

16bit	VGA card 256K 800x600	£29.95
16bit	VGA 512K 1024x768	£59.50
16bit	VGA 1Mb 1024x768x256	£79.50
Hercules	/ printer card	£12.95
Amber	TTL 12" Monitor	£85.00
VGA	Paper White 14" on-site	£89.50
VGA	Colour 1024x768 on-site	£260

I/O Cards

16bit	controller 2xFDD and 2 x IDE HDD	£18
With	Serial, Parallel & Games port on board	£29
2Ser,	Par, Games	£12.95

Cases with PSU

Fliptop	Case 200W	£75.00
Smart	Desktop 200W	£87.50
Tower	Case 220W	£169

Carriage on Motherboards, Floppy drives & Keyboards £5, Mice & Controller cards £3, Hard disks, Cases & Monitors £10, IC's free if over £20 nett, otherwise add 75p. VAT to be added to total. Full list of IC's, computers and computer parts on request.



Happy Memories, FREEPOST,
Kington, Herefordshire HR5 3BR
Tel (054 422) 618 Fax (054 422) 628



Eagle Publications.

8 Super circuits for every occasion. Tracker, telebug, sensitive Xmitter, bug detector etc. Excellent quality. Yours for only £6.75 including postage, payable to Eagle Publications.

Cheques and Postal Orders to
Eagle Publications
P.O. Box IW27
Leeds
LS16 6TU.



SHERWOOD ELECTRONICS

9 Lower Birchwood, Somercotes, Derbyshire DE55 4NG

£1 Special Packs - Now even better value. Select 1 pack FREE for every 10 purchased

SP1	15 x 5mm Red Leds	SP38	25 x 47uf/25V radial caps.
SP2	15 x 5mm Green Leds	SP39	12 x 470 uf/16V radial caps
SP3	12 x 5mm Yellow Leds	SP42	200 x Mixed 0.25W C.Film resistors
SP6	15 x 3mm Red Leds	SP44	12 x 5mm Leds-4 ea. Red, Grn., Yel.
SP10	100 x 1N4148 diodes	SP46	20 x 400mW zener diodes
SP11	30 x 1N4001 diodes	SP48	15 x Axial caps
SP12	30 x 1N4002 diodes	SP102	20 x 8 pin DIL sockets
SP18	20 x BC182 transistors	SP103	15 x 14 pin DIL sockets
SP19	20 x BC183 transistors	SP104	15 x 16 pin DIL sockets
SP20	20 x BC184 transistors	SP105	6 x 74LS00
SP23	20 x BC549 transistors	SP106	6 x 74LS02
SP24	6 x Cmos 4001	SP110	5 x 74LS13
SP25	5 x 555 timers	SP112	6 x Cmos 4093
SP26	5 x 741 Op-amps	SP113	12 x 1N5400 diodes
SP28	6 x Cmos 4011	SP119	6 x Cmos 4072
SP29	4 x Cmos 4013	SP121	8 x Rect. Red Leds 5 x 2mm
SP31	5 x Cmos 4071	SP122	8 x Rect. Green Leds 5 x 2mm
SP33	5 x Cmos 4081	SP123	5 x Rect. Yellow Leds 5 x 2mm
SP36	25 x 10uf/25V radial caps.	SP124	20 x Assorted ceramic disc caps
SP37	20 x 100uf/35V radial caps	SP125	10 x 1000uf/16V radial caps

All new and full spec. components

1992 Catalogue now available £1 Contains vouchers redeemable against orders

Cheques or P.O. to **SHERWOOD ELECTRONICS** Please add £1 P&P to all orders

NEW 1992 CATALOGUE

CRICKLEWOOD ELECTRONICS

CRICKLEWOOD ELECTRONICS LTD, 40 CRICKLEWOOD BROADWAY, LONDON NW2 3ET
Tel: 081 452 0161 Fax: 081 208 1441

BOOKS	BOXES & CASES	CABLE & WIRE	CAPACITORS	CONNECTORS	KITS
RESISTORS	SEMI-CONDUCTORS	SPEAKERS	VIDEO HEADS	SWITCHES	TOOLS & BENCHWARE

SEND NOW FOR THE **CRICKLEWOOD ELECTRONICS** COMPONENT CATALOGUE
ONE OF THE BEST RANGES AVAILABLE

Name

Address

Please send copies of Cricklewood Electronics Catalogue at £2.00 each. Make cheque out to Cricklewood Electronics Co.

CYCLE LIGHT BACK-UP

T. R. de VAUX-BALBIRNIE

Be safe – be seen!

ANYONE who regularly rides a bicycle at night will know that cycle lamp batteries are a very expensive way of obtaining energy. One way of reducing costs is to use a dynamo lighting set but here the brightness of the lights is speed dependent.

At normal road speed they give good light. Unfortunately, they go off or become dim at times when you need to be most conspicuous – when stopped at a junction, for example, and this can be extremely dangerous.

BASIC OPERATION

On the other hand, a dynamo provides free energy and avoids the high cost of batteries. This circuit is a hybrid design which uses a dynamo to provide power while the output is sufficient, but switches over to battery operation when it falls below a certain level.

A pack of four "C" size alkaline cells are used for the back-up supply. These will last for a long time because they have only light duty use. The battery pack is housed in an aluminium or plastic box, together with the control circuitry. This box is clipped or bolted to the bicycle frame.

There is an ON-OFF switch on the unit (this is necessary to switch off the lights when the cycle is left standing). The dynamo will still operate when the circuit is switched off but, of course, there will be no back-up supply available. Note that most of the space inside the box is taken up by the battery pack. Even so, it would not be advisable to reduce the size of the unit by using smaller batteries.

The circuit is *fail safe* – in the event of the dynamo supply not working for any reason, the lights will assume *back-up* operation. In such use, the batteries should give several hours of operation.

MAKING WAVES

A bicycle dynamo is better described as an *a.c.* (alternating current) generator. In use, the rim of the tyre turns a wheel and spindle which rotates a magnet rapidly, close to a coil of copper wire wrapped on a soft-iron core. This produces the voltage which drives current through the bulb.

The value of this voltage rises and falls with the position of the magnet – that is, it performs *sine waves* (see Fig. 1a). In a complete 360 degrees, it rises to a maximum in one direction and falls to zero then repeats in the opposite direction. The number of

times it does this each second is called the *frequency*.

The dynamo output is rather like the household mains supply but, of course, of a much lower average voltage – some 6V rather than 240V. Note that the word "average" is used here because the voltage is continually rising and falling and never has a steady value.

The term "r.m.s. voltage" is a better one – this is the value that a *steady* voltage would have if it produced the same effect. Thus, if the dynamo output was 6V r.m.s., a lamp connected to it would have the same brightness as when connected to a steady 6V supply such as a battery.

An a.c. supply is perfectly suitable for operating bicycle lights – at normal speeds the frequency is sufficient for there to be no noticeable flicker. However when travelling very slowly, the lamp becomes dim and flickering becomes apparent.

DYNAMO OUTPUT

The r.m.s. voltage output of a dynamo depends on several factors – chiefly the strength of the magnet, the number of turns on the coil and the speed of rotation. In a given system, these are all fixed apart from the rate of rotation of the magnet which in turn depends on the road speed. The bicycle lamp bulbs are of 6V rating and the dynamo is designed to match this with 6V

r.m.s. output when the cycle is travelling at normal road speed.

As far as a power supply for an add-on circuit is concerned, the bicycle dynamo must rank as one of the most difficult to use successfully. There are a number of reasons for this. Firstly, the voltage fluctuates randomly as well as rising and falling with speed (due to variations in spindle speed on account of the poor drive arrangement on the wall of the tyre) also, the frequency varies in the same way and for the same reasons. Thirdly, and as it turns out most importantly, the off-load voltage output is markedly greater than the on-load one.

Measurements show that the typical resistance of a dynamo coil (the internal resistance) is five ohms approximately. When 500mA (the normal total operating current) flows through this resistance, Ohm's Law predicts that there will be a voltage of:

$$V = I \times R = 0.5 \times 5 = 2.5V$$

appearing across it.

This voltage is "lost" as far as the bulbs are concerned. Thus, the dynamo output must be some 8.5V for 6V to be applied to the bulbs. The importance of this point will be explained presently since it turns out that it causes the greatest problem.

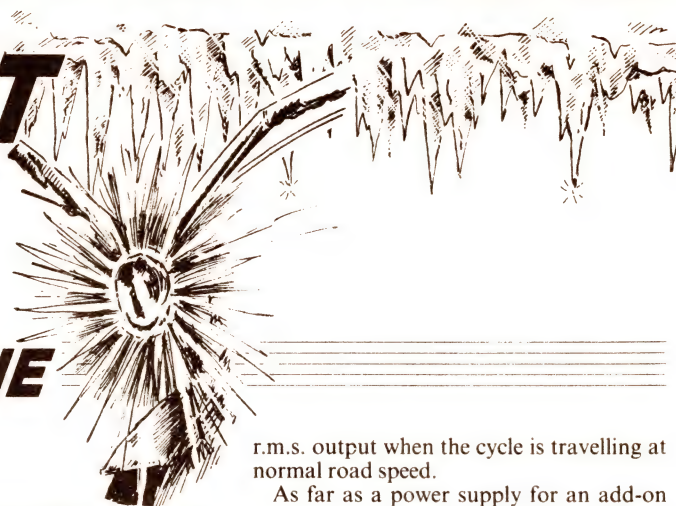
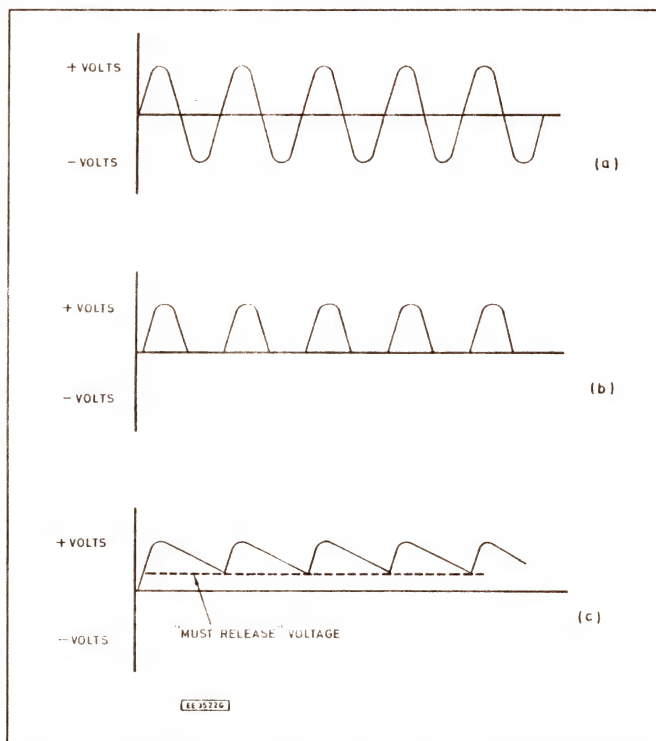


Fig. 1a. *Sine wave output (a.c.) produced by the cycle dynamo.*

Fig. 1b. *Half-wave rectification of the a.c. sinewave by diode D1*

Fig. 1c. *The effect of the "fill-in" capacitor C1 on the half-wave cycle. This keeps the relay energised during dynamo operation and hence feeds the dynamo supply to the cycle lights.*



CIRCUIT DESCRIPTION

The entire circuit for the Cycle Light Back-Up is shown in Fig. 2. Assume for the moment that the dynamo is turning at normal road speed and that the coil of relay, RLA, is energized. The normally-open contacts, (n.o.) RLA1, are therefore closed.

Current from the dynamo flows through these contacts and hence to the front and rear lights in the usual way. The current completes the circuit back to the dynamo through the metal frame of the bicycle and the lights operate normally.

At the same time, current flows through diode, D1, which half-wave rectifies the a.c. by allowing only the positive half-cycles through (see Fig. 1b). This charges capacitor, C1. Zener diode, D2, in conjunction with fixed resistor, R1, limit the voltage across C1 to 5.1V which is just a little higher than the relay operating voltage (6V is the nominal operating voltage but the relay cuts in at a lower voltage than this – typically 4.5V).

Capacitor C1 acts as a reservoir of electric charge which can “fill in” with current when the dynamo output falls off between half-cycles (Fig. 1c). The relay coil therefore receives current continuously and is kept energized.

When the road speed and hence the dynamo output falls, there will come a time when the voltage across C1 matches the Zener voltage and the voltage across it will now fall. The relay therefore “drops out” and the normally-closed contacts, (n.c.) close. This allows current to flow through the lamps from the back-up (battery) supply.

PROBLEM

A problem occurs when the voltage across C1 falls to the switching point. At the instant of the relay operating and the bulb switching over from dynamo to back-up supply, the dynamo voltage will suddenly rise as the load is removed (as explained earlier). This could cause the relay coil to energize once again. The voltage would then fall and the cycle repeat.

The outcome would be *relay chatter* which would be a nuisance as well as causing unnecessary operation and possible early failure of the relay. Reducing this effect is the purpose of the Zener diode, D2.

While the dynamo voltage is sufficient, this “locks” the voltage across C1 to 5.1V maximum so, as the switching point is reached and the dynamo output rises, the voltage across C1 remains virtually constant and the relay is prevented from operating again. Preset VR1 acts as a “fine tuning” control of the switching point and this will be adjusted for correct operation at the end of construction.

There is a further complication which arises from the operating characteristics of relays. It is found that a relay which operates as the coil voltage approaches 5V will not switch off again until a much lower voltage (the *must release* voltage) is reached – typically between 0.5V and 1.5V. In the above simplified explanation, the lights would have to become dangerously dim before the back-up supply took over.

To overcome this problem, the value of capacitor C1 is carefully chosen. Thus, when the dynamo output cannot maintain the Zener diode and the voltage across C1 falls below 5.1V, the voltage between the peaks is allowed to fall to the *must release* voltage (Fig. 1c). This is helped by the reduc-

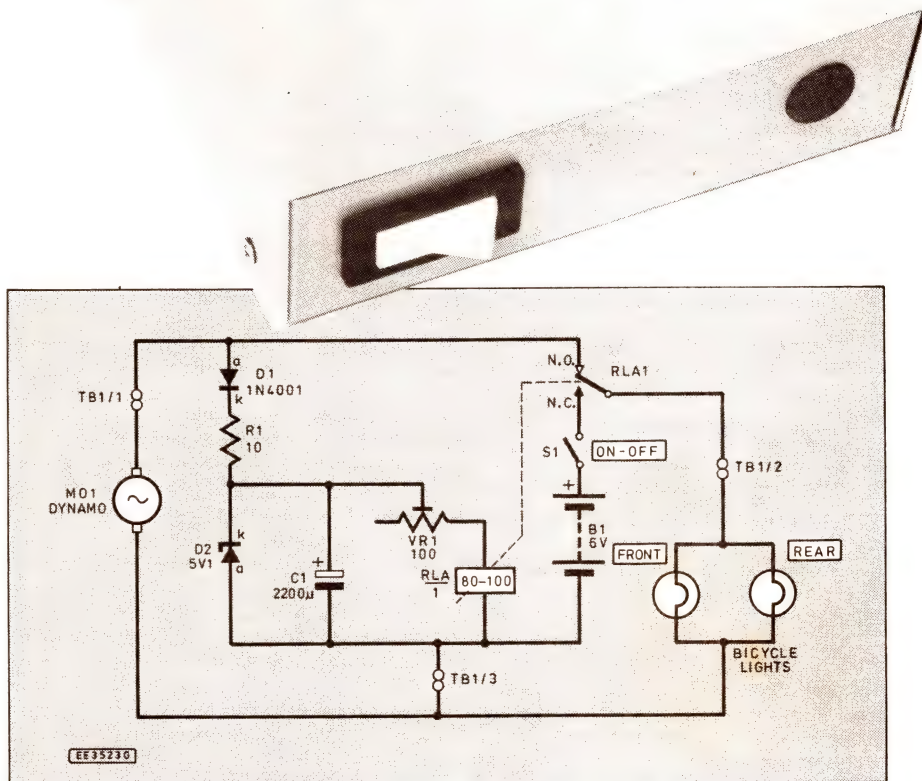


Fig. 2. Complete circuit diagram for the Cycle Light Back-Up.

ing dynamo output frequency since it becomes more difficult for the capacitor to “fill in” the increasing space between successive peaks.

The value of C1 specified in the components list give good results when used in conjunction with the specified relay. However, electrolytic capacitors have a wide tolerance range and varying the value of C1 could be the subject of experiment later if a different relay is used.

CONSTRUCTION

Note that an ordinary aluminium box was used to house the prototype unit. However, it may be necessary to use a *waterproof* metal or plastic one – it depends on the type of use it will have. It may also be necessary to waterproof the switch and the entry point for the wires into the box.

Construction of the Cycle Light Back-Up is based on a circuit panel made from a piece of 0.1 inch matrix stripboard size 12 strips x 21 holes. Fig. 3 shows full topside details and breaks required in the underside copper strips. Begin by cutting the material to size, drilling the two mounting holes and making all track breaks and the inter-strip link as indicated. Follow with the soldered on-board components.

Note that diodes, D1 and D2, also capacitor, C1, are *polarised* components and must be connected the correct way round. The specified relay fits the 0.1 inch matrix – if any other type of relay is used, some modifications may be needed. Solder

COMPONENTS

Resistor

R1 10 carbon film 1W

Potentiometer

VR1 100 0.25W vertical preset

Capacitor

C1 2200µ radial elect. 16V

Semiconductors

D1 1N4001 50V 1A rectifier diode
D2 5V1 1W Zener diode

Miscellaneous

B1 “C” size alkaline cells – 4 off, plus cell holder and connector
S1 Miniature s.p.s.t. rocker, toggle or slide switch
RLA Sub-miniature relay with 100 ohm 6V coil and single-pole changeover contacts rated at 2A d.c.
TB1 3A screw terminal block – three sections required

Aluminium or plastic box, size 125mm x 105mm x 35mm approx.; 0.1in matrix stripboard, size 12 strips x 21 holes; small fixings; connecting wire; rubber grommet; solder, etc.

Approx cost guidance only

£8.50

excl. batts.

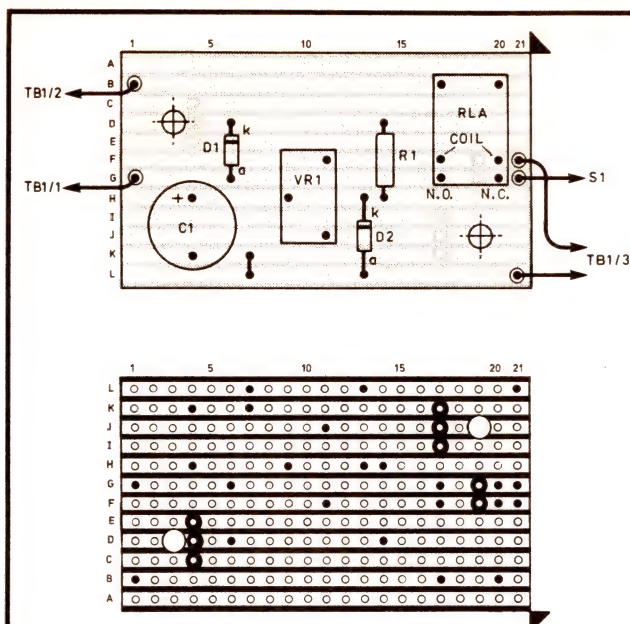
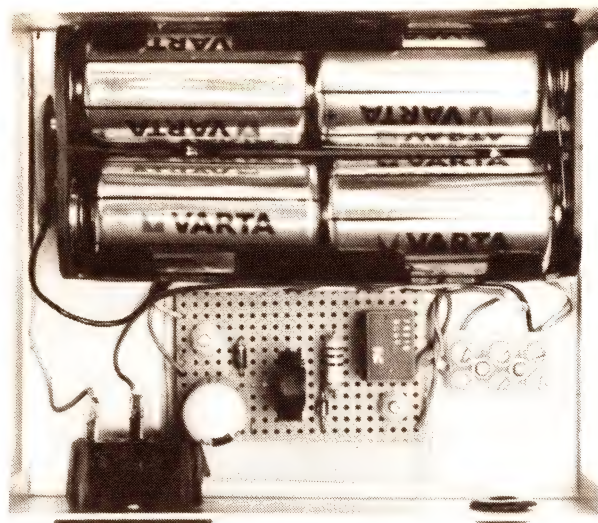


Fig. 3. Stripboard component layout and details of breaks required in the underside copper tracks.



Completed unit showing layout and wiring of components inside the metal case. Suitable clips, such as "Terry" clips, for attaching the case to the cycle frame must be fixed to one of the side panels.

10cm pieces of light-duty stranded connecting wire to copper strips *B* and *G* on the left-hand side and to strips *F*, *G* and *L* to the right as indicated.

Drill holes in the box for switch *S1*, battery pack *B1*, terminal block *TB1* and for circuit panel mounting. Drill also a hole for the three wires which will pass through the box to *TB1*. Fit this hole with a rubber grommet.

Drill a hole for the spring clip or other attachment which will hold the unit in position on the bicycle frame. Mount all remaining components and, referring to Fig. 4, complete the internal wiring.

If an aluminium box is used, the circuit panel should be mounted on a piece of thick cardboard so that the soldered connections on the copper strip side cannot touch the metalwork. Note that everything is mounted in the main section of the box with nothing on the lid. This imposes least strain on the interconnecting wires.

CONNECTIONS

Fit the dynamo and lights to the bicycle if they are not fitted already. Do not connect the wire leading from the dynamo terminal to the lights. Using light-duty stranded connecting wire, connect the dynamo terminal to *TB1/1* on the unit.

Connect the wire leading to the lights to *TB1/2* and connect *TB1/3* to the bicycle frame. This connection could be made by drilling a small hole and using an eyelet secured with a self-tapping screw. Alternatively, a wire may be run to either the dynamo or a lamp casing which is already connected to the frame.

Tie a piece of string firmly or fix a strain relief bush around the wires inside the box at the point where they pass through the rubber grommet to provide strain relief. Leave preset *VR1* adjusted to approximately mid-track position.

TESTING

Insert the batteries into their holder but leave *S1* switched off for the moment. Engage the dynamo. Now, with the bicycle upside-down and with the help of an assistant, turn the bicycle wheel and increase the speed smoothly.

At some point, the relay should click and the lights come on. If nothing happens, adjust *VR1* slightly anti-clockwise (as viewed from *C1* position). Check that the cut-in happens smoothly and the relay does not chatter. Adjust *VR1* for best effect – clockwise rotation raises the cut-in speed.

Now, switch *S1* on. The lights should operate from the back-up supply. Turn the bicycle wheel again and check that the dynamo takes over reliably. When this happens, the relay will click and you will see a change in brightness at the switching point. If all is well, the unit may be attached permanently to the bicycle frame.

RE-CHARGEABLE

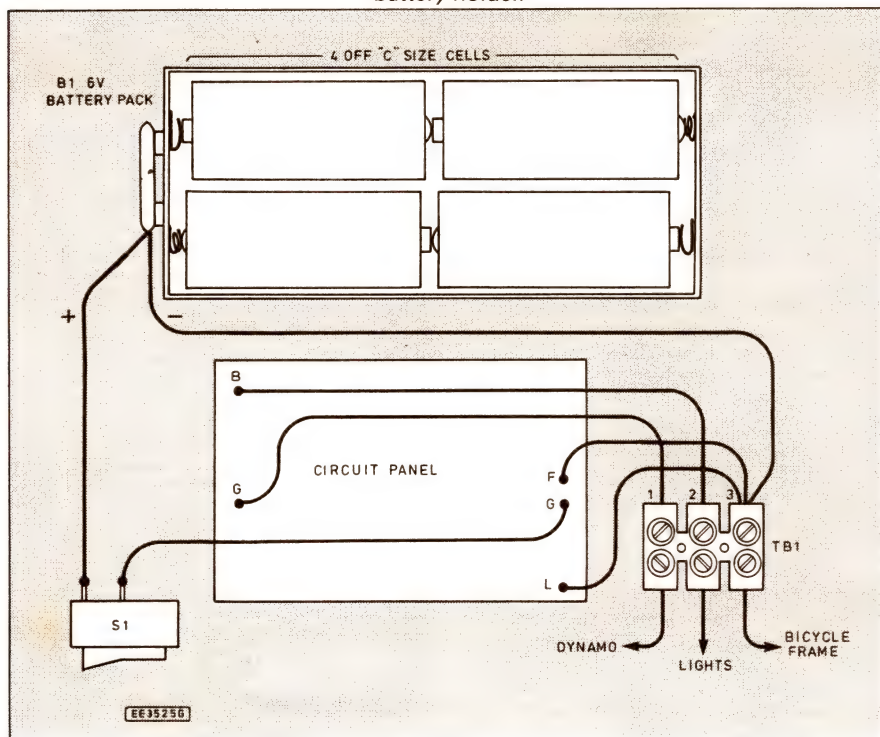
Some readers may wish to carry cost saving one step further and use *nickel-cadmium* (rechargeable) batteries for the back-up supply. This is **not really advisable** for the following reasons. Firstly, towards the end of their charge, the voltage of a nickel-cadmium battery, unlike a standard alkaline one, falls off quickly and this could result in sudden failure.

Ni-Cad batteries also tend to self-discharge fairly rapidly and they have a lower capacity than the alkaline variety. Another point is that four nickel cadmium cells give an output voltage of only 4.8V normal rather than 6V for alkaline ones (although this would hardly be a problem in practise).

Any reader who is determined to use nickel-cadmium batteries will need to recharge them before each trip and carry a set of alkaline ones too "just in case". Alternatively alkaline ones can be recharged using the *Dry Cell Recharger* from EE, September 1991 issue.

It only remains to give the bicycle a road test and to make any final adjustments to preset *VR1*. Don't be surprised if there is a slight tendency for relay chatter when the road speed dithers around the switching point. This will not happen very often and will do no harm. Happy cycling! □

Fig. 4. Interwiring from the circuit board to the terminal block, switch and battery holder.



HART

HART AUDIO KITS – YOUR VALUE FOR MONEY ROUTE TO ULTIMATE HI-FI

HART AUDIO KITS give you the opportunity to build the very best engineered hi-fi equipment there is, designed by the leaders in their field, using the best components that are available.

Every HART KIT is not just a new equipment acquisition but a valuable investment in knowledge, giving you guided hands-on experience of modern electronic techniques.

In short HART is your 'friend in the trade' giving you, as a knowledgeable constructor, access to better equipment at lower prices than the man in the street.

You can buy the reprints and construction manual for any kit to see how easy it is to build your own equipment the HART way. The FULL cost can be credited against your subsequent kit purchase.

Our list will give you fuller details of all our Audio Kits, components and special offers.

AUDIO DESIGN 80 WATT POWER AMPLIFIER.



This fantastic John Linsley Hood designed amplifier is the flagship of our range, and the ideal powerhouse for your ultimate hi-fi system. This kit is your way to get 2K performance for a few tenths of the cost! Featured on the front cover of 'Electronics Today International' this complete stereo power amplifier offers World Class performance allied to the famous HART quality and ease of construction. John Linsley Hood's comments on seeing a complete unit were enthusiastic:- The external view is that of a thoroughly professional piece of audio gear, neat elegant and functional. This impression is greatly reinforced by the internal appearance, which is redolent of quality, both in components and in layout. Options include a stereo LED power meter and a versatile passive front end giving switched inputs using ALPS precision, low-noise volume and balance controls. A new relay switched front end option also gives a tape input and output facility so that for use with tuners, tape and CD players, or indeed any other 'flat' inputs the power amplifier may be used on its own, without the need for any external signal handling stages. 'Slave' and 'monobloc' versions without the passive input stage and power meter are also available. All versions fit within our standard 420 x 260 x 75mm case to match our 400 Series Tuner range. ALL six power supply rails are fully stabilised, and the complete power supply, using a toroidal transformer, is contained within a heavy gauge aluminium chassis/heatsink fitted with IEC mains input and output sockets. All the circuitry is on professional grade printed circuit boards with roller tinned finish and green solder resist on the component input side, the power amplifiers feature an advanced double sided layout for maximum performance. All wiring in this kit is pre-terminated, ready for instant use!

RLH11 Reprints of latest articles.....£1.80
K1100CM HART Construction Manual.....£4.50

LINSLEY HOOD 'SHUNT FEEDBACK' R.I.A.A. MOVING COIL & MOVING MAGNET PICKUP PREAMPLIFIER



Modern, ultimate sound systems are evolving towards a built-in RIAA preamplifier within the turntable unit, keeping noise pickup to a minimum. This new circuit by John Linsley Hood uses latest generation integrated circuits in the sonically preferred shunt feedback configuration to give an accurate and musical sound, with the ability to use both moving magnet and moving coil cartridges. Power comes from two 9v PP3 size batteries or a mains power supply. This HART kit is exceptionally easy to build with detailed instructions and all the specially selected components fitting directly on to the roller tinned fibreglass printed circuit board. Even the gold plated phono sockets mount directly on the board.

This Kit now comes with latest generation low-noise front end IC and onboard power stabilisers for any DC input voltage between 9v and 30v.

K1500 Special Discount Price for complete Kit.....£67.99

ALPS PRECISION LOW-NOISE STEREO POTS.



To fulfil the need for higher quality controls we are now importing an exciting new range of precision audio pots in values to cover most quality amplifier applications. All in 2-gang stereo format, with 20mm long 6mm dia. steel shafts. Now you can throw out those noisy ill-matched carbon pots and replace with the real hi-fi components only used selectively in the very top flight of World class amplifiers. The improvement in track accuracy and matching really is incredible giving better tonal balance between channels and rock solid image stability. Motorised versions have 5v DC Drive motor.

2-Gang 100K Lin.....£8.86
2-Gang 10K, 50K & 100K Log.....£9.60
2-Gang 10K Special Balance.....£10.71
2-Gang 20K Log MOTORISED.....£19.20
2-Gang 10K Special Balance, MOTORISED, zero crosstalk and < 10% centre loss with near Log/Antilog Tracks.....£19.98

HIGH QUALITY REPLACEMENT CASSETTE HEADS



Do your tapes lack treble? A worn head could be the problem. For top performance cassette recorder heads should be replaced every 1,500 hours. Fitting one of our high quality replacement heads could restore performance to better than new! Standard inductances and mountings make fitting easy on nearly all machines (Sony are special, see below) and our TC1 Test Cassette helps you set the azimuth spot on. As we are the actual importers you get prime parts at lower prices, compare our prices with other suppliers and see! All our heads are suitable for use with any Dolby system and are normally available ex stock. We also stock a wide range of special heads for home construction and industrial users.

HM120 Standard Mono R/P Head.....£3.51
HC15 Standard Quality Stereo R/P Head.....£2.49
HC66 High Quality Stereo R/P Head, Permalloy.....£7.98
HS16 Sendust Alloy Stereo Head.....£16.85
HC80 NEW RANGE High Beta Permalloy Stereo head. Modern space saver design for easy fitting and lower cost. Suitable for chrome metal and ferric tapes, truly a universal replacement head for everything from hi-fi decks to car players and at an incredible price too!.....£8.30
HQ551 4-Track RECORD & Play Permalloy Head for auto-reverse car players or quadraphonic recording £14.90
H524 Standard Erase Head.....£1.90
H561 Hi Field Erase Head for METAL Tapes.....£3.49
HRP373 Downstream Monitor Stereo Combination Head.....£47.90

Many other SPECIAL cassette Heads in stock, see our LIST.

REEL TO REEL HEADS

999R 2/4 Record/Play 110mH. Suits Stuart Tape Circuits.....£13.64
998E 2/4 Erase Head 1mH. Universal Mount. Suits Stuart.....£11.98

TAPE RECORDER CARE PRODUCTS

HART TC1 TEST CASSETTE Our famous triple purpose test cassette. Sets tape azimuth, VU level and tape speed.....£5.36
DEM1 Mains Powered Tape Head Demagnetizer, prevents noise on playback due to residual head magnetisation.....£4.48
DEM115 Electronic, Cassette Type, demagnetizer.....£8.91

COMPUTER CORNER

The following are a selection of our new range of VERY competitively priced, High Quality, computer systems. Due to our long experience of importing we have the necessary contacts in the Far East to buy at very advantageous prices and can pass the savings on to you. All hard disc machines ordered with DOS are fully formatted and ready to use.

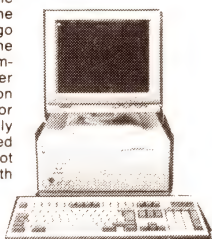
HART MODEL AT-286/16WP COMPUTER

Fully fledged AT286 machine, cheap enough to use as the fastest wordprocessor in the west! Only a few years ago the AT-286 machine was the fastest standard office computer known. Now we can offer the superfast 16MHz version (earlier ones were only 10 or 12MHz) at such an incredibly low price that it can be used in any office or home. Not only that but ours comes with ultrafast memory so that the machine can run in 'zero wait state'.

Advanced features are:- Full 1MB of memory (Expandable to 4MB), 102 key UK keyboard, compact desktop case, 1.2MB 5 1/4" High Density Disk Drive and interface card for extra drive. Graphics/Printer Card, built in Hard Disk Interface.

HART AT-286/16WP.....ONLY £277.25
14" FST Hercules monitor, Amber.....£83
14" Paper White Hercules Monitor. (Both have T/S Base).....£86

Trust Writer W/P Software uses Wordstar commands £19.50
40MB AT-286/16UG Hard Disk Computer
Specification as above but with 45MB 25ms hard disc, VGA Colour Graphics Card with 512K RAM, parallel printer port, 2 serial ports, 1 game port.....£523.50
14" VGA Mono Monitor, Amber £86.70 Paper White £89



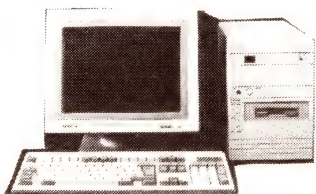
HART 40MB AT-386/16SX EL



Entry level 386 machine for demanding applications at moderate cost. Spec as our AT286/16WP with 1MB Dram memory, Mini Tower case, 45MB 25ms hard disc drive, VGA Colour Graphics Card with 256K RAM

40MB AT-386/16SX EL is.....ONLY £634.30 (Ex Vat)

HART 52MB AT-386/20SX UG



Luxury version of the above with higher processor speed and amazing 9 millisecond access time hard disc. 2MB SIMM RAM, Compact Tower Case, VGA 1024 x 768 card with 512K RAM, upgradeable to 1MB of Video memory.
40MB AT-386/20SX UG.....ONLY £853.10

OPTIONAL EXTRAS

HART Computers can be 'custom made' to fit your personal

requirements, at NO extra cost! Simply select the options you require. If replacing any item in the standard specification for that model then deduct the cost of the part not needed.

SOFTWARE

MS-DOS 5 Latest Release. Full version 3.5" or 5.25".....£59
DR DOS 6.....£77
Microsoft Windows 3.3.5" or 5.25" Disks.....£65

MONITORS

SM1421 AM TU Hercules Mono with FST Tube and Stand, Amber.....£83
SM1421 PW TU As Above but Paper White Screen.....£86
SM1416A VGA Mono Monitor c/w tilt and swivel stand, Amber.....£86.70
SM1416W As Above, Paper white.....£89
SM1485-00 Super VGA Multisync Colour Monitor, 28" dot pitch, 50MHz Bandwidth, up to 1024 x 768, c/w stand.....£235

KEYBOARDS

K261 102 Key Enhanced UK Layout, Tactile Click, AT/XT Switchable with dual slope feet. (Standard Keyboard supplied with systems).....£31
K108 Similar to above, single slope feet, Alps switches.....£36
KB6153A As above but with heavy metal base.....£44

I/O and GRAPHIC CARDS

AT Super I/O Card 2 x FDD, 1xIDE, 2 Serial, 1 Parallel, 1 Game Ports.....£21.20
Hercules Mono Graphic & Printer card.....£11.70
16-Bit VGA Card, 256K.....£46.50
Trident 8900 VGA Card, 512K.....£67.30
Trident 8900 VGA Card with 1Mb.....£86.90

DISK DRIVES

5.25" 1.2Mb Floppy Disk Drive.....£49
3.5" 1.44Mb Floppy Disk Drive.....£45
Adapter to fit 3.5" drive in 5.25" slot, c/w power adapter.....£9
45MB 25ms Hard Disk Drive.....£165
52MB Quantum Hard Disk. Lightning Fast 9ms Access time.....£261

CASES

WE 611P Desktop Case, Flip Top, 200W PSU.....£56.40
WE727P Mini Tower Case, 200W PSU.....£84.70
108MP Mini Tower Case, Compact Style.....£89
CT107 Midi Tower Case.....£108

MOTHERBOARDS

AT-286/160K RAM.....£89
AT-386-16SX 0K RAM.....£195
AT-386-20SX 0K RAM.....£245

PLEASE NOTE THAT ALL ITEMS IN THIS SECTION ARE PRICED EX VAT.



MANUFACTURERS OF QUALITY AUDIO KITS AND COMPUTERS

24 hr. SALES LINE (0691) 652894

AUDIO KIT PRICES are VAT INCLUSIVE. COMPUTER PRICES EXCLUDE VAT

HART ELECTRONIC KITS LTD
6 PENYLLAN MILL
OSWESTRY, SHROPSHIRE
SY10 9AF

ACTUALLY DOING IT!

by Robert Penfold

THIS month's *Actually Doing It* article has been written in response to a letter from a confused reader. His letter was basically a request for an explanation of screening, which is an important topic, but one that receives little attention. I suppose that it is one of those things that tends to be considered too simple to be worthy of much explanation, but which nevertheless manages to confuse many newcomers to the hobby.

STRAY COUPLING

This is not the place for a technical discussion about screening, but it is something that is easier to deal with if you understand the basic problem. This is simply one of an unwelcome electrical signal finding its way into one of your circuits. There are plenty of sources of electrical signals that can cause problems. The two most common ones are the mains supply (and appliances connected to it), and radio transmitters. The average house is awash with signals of both types.

In the case of radio transmissions, the signals are picked up by the wiring in your project which acts as a crude aerial. These signals might actually go unnoticed, but they will often cause problems. I once had a hi-fi system which over a period of time picked up Radio Sweden, Radio Moscow, The BBC World Service, and several unidentified stations. This would not be remarkable except that it happened when I was listening to the record player!

Stray coupling of signals into one of your projects can occur just as easily at audio frequencies. Two wires, even if they are some distance apart, will effectively form a low value capacitor. This capacitance can couple a signal from one wire to the other. The same two wires can also act as a very basic transformer, again providing a link from one to the other.

We are talking here about very weak and inefficient links from one wire to another, but bear in mind that electronic circuits are often dealing with minute signals. Even a millionth of a volt at the input of a sensitive audio amplifier can produce an audible output. The circuits that are most vulnerable to stray pick-up are ones which work with very small signals, very high impedance signals, or worst of all, very small and very high impedance signals.

FEEDBACK

Signals in the outside world are not the only problem. There can be stray pickup from one part of a circuit to another. In particular, there can be severe problems

if there is significant stray coupling from the output to the input of an amplifier. This can easily result in the circuit breaking into oscillation.

As stray feedback occurs more readily at high frequencies, the amplifier will usually oscillate at an ultrasonic frequency, giving a tone from the speaker that is inaudible. However, the output quality will probably suffer quite noticeably, and with multi-way speakers there could well be smoke from the overloaded tweeters!

This type of stray pickup is difficult to deal with because the small size of modern electronic equipment tends to result in small distances between the input and output wiring. This makes it relatively easy for signals to make an unwanted trip from one part of the circuit to another. Screening can help, but the designer must produce a carefully worked-out layout that provides no easy paths for stray feedback.

SCREENING

Screening is basically just a layer of earthed metal between sensitive wiring and any possible sources of electrical interference. The easiest way to keep signals in the outside world away from your circuits is to house your projects in metal cases.

Diecast aluminium boxes are generally regarded as providing the best screening, but any case of all-metal construction should do the job quite well. The case should be connected to the earth rail of the circuit, which these days almost invariably means connecting it to the negative supply rail.

This earthing is often provided via sockets on the front panel without the need for any deliberate connection. For example, most jack sockets which have metal mounting bushes have these bushes in electrical contact with their earth tags. However, where necessary a connection can be made to the case via a soldertag bolted to an otherwise vacant spot on the base panel.

Soldering direct to a metal case is very difficult even if you have the right kind of solder. The bit of the iron and the solder tend to instantly "freeze" as they come into contact with the case, which acts as a large heatsink.

SCREENED LEADS

Leads that carry low level signals between devices, such as from a record deck or microphone to an amplifier, must be screened types. In some cases it is necessary for some of the leads within a project to be of the screened variety. This

is sometimes to prevent stray pickup of mains "hum" from an internal mains power supply, while in other cases it is necessary to avoid stray feedback.

The most simple type of screened lead is the quaintly named "twisted pair". A cable of this type is just two insulated leads which are twisted together to produce a crude form of two way cable. One wire is connected to earth and the other carries the signal. This type of cable does not seem to be used much in practice, and I have never used this method of screening. I did once review a hi-fi amplifier which was devoid of ordinary screened cables, and instead used a number of twisted pairs. This amplifier was free from mains "hum", so it would seem to work quite well.

Normal screened cables have an inner conductor, which for audio cables is normally in the form of multi-strand wire. This is surrounded by the usual p.v.c. insulation, and this is in turn covered by a sort of mesh of wire. Finally, there is an overall sheath of plastic. In use the mesh of wire connects to earth and screens the inner conductor from electrical signals.

The wire mesh can take a number of forms. Sometimes it is woven to form a braiding, while in other cases the wires are simply laid side by side and twisted around the inner conductor and sleeving. This second method is known as lap-screening.

These are the only types of screened cable you will normally need to use, but there are other types. One you might encounter is cable which has a thin metal foil to back-up the normal braid or lapped screen, and give greater immunity to stray pickup. These days there seems to be a trend towards cables which have braiding plus a semiconducting plastic material such as metallised mylar. Like the metal foil, this is used to improve the quality of the screening.

COAXIAL CABLE

There are special "coaxial" screened cables for carrying radio frequency signals. These are actually much like audio screened cables in their general make-up, but they are designed to have a certain impedance (75 ohms in the case of ordinary television aerial cable for instance). At radio frequencies the wavelengths are quite short, and there can be problems with standing waves. What this means in practice is that the source, cable, and load impedances all have to be properly matched, or a substantial percentage of the input signal will be lost in the cable.

If a components list specifies that a coaxial cable of a particular impedance should be used, then it is important to do so. At audio frequencies the wavelengths are much longer, and cable impedances are not something that you have to worry about when building audio circuits. In fact for normal audio use practically any screened cable should suffice. For something critical like a long microphone lead which will carry minute signals, it would probably be worthwhile investing in a very high quality cable. For most purposes though, a thin and inexpensive screened lead is probably the most practical choice.

MULTI-WAY CABLES

In most component catalogues you will find several types of multi-way screened cable listed. Basically though,



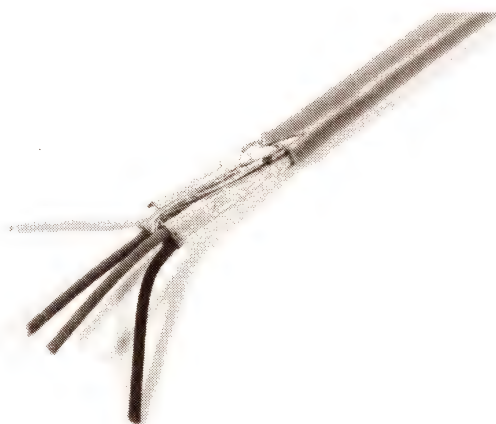
A single screened lead with a braided screen. Some braided screens are much more substantial than this one.



A single screened lead with its end prepared and ready for connection.



Twin overall lap-screened cable. The wires in the screen are easily twisted together to form a single lead.



This four-way screened cable has the inner conductors screened in pairs. It includes foil screens.

there are just two different types of multi-way screened cable. These are the individually and overall screened varieties. Individually screened cable is the more expensive type, and it is effectively just two or more ordinary screened cables, but with a common sheath to bind everything together as a single cable. Overall screened cable has one screen covering two or more inner conductors.

There is an important difference in the electrical characteristics of these two types of cable. With the individually screened type the inner conductors are not just screened from the outside world, they are also screened from each other. This type of cable is used in an application where it is important that there is no stray coupling from one lead to another. The most common example of this is a stereo system, where any stray coupling from one channel to the other would obviously reduce the stereo separation.

OVERALL SCREEN

With an overall screen there is nothing to prevent stray coupling between the inner conductors. With the leads in such close proximity to one another there is likely to be very strong coupling between them, particularly if a long cable is involved. This renders overall screened leads unsuitable for most audio applications.

They are mainly used in computer applications, wiring-up MIDI electronic music systems, and this sort of thing. It is perhaps worth pointing out that in these applications the purpose of the screening is not to keep out signals from the outside world. It is needed to prevent the inner conductors from radiating radio frequency interference. Screening will keep signals in as well as out.

If a components list specifies overall screened cable, it is perfectly all right to use an individually screened type. However, you would be using a more expensive cable than was really needed. It is not a good idea to use overall screened cable where an individually screened type is specified. To do so would probably not prevent the project from working, but it could seriously degrade certain aspects of its performance.

CONNECTIONS

Connecting screened leads to sockets etc. is a bit fiddly, but is not really too difficult. About 10 to 15 millimetres of the outer sheath must first be removed from the end of the cable. With the thinner cables this can be done using ordinary wire strippers provided you proceed carefully. On the larger cables the sheath can be quite thick, and it is then usually necessary to carefully cut it away using a sharp modelling knife.

Either way, try not to damage the wires in the screen.

With lap-screened cable the exposed screen wires are twisted together to form a single lead, and then they are tinned with plenty of solder to hold them all together properly. This gives you a lead which can be connected to most tags, pins, etc. without difficulty. The inner conductor is treated in the same way as any insulated connecting wire. Check for any odd wires sticking out from the screen, and trim off any that you find. Otherwise these could easily cause short circuits.

Braided cable can be slightly more awkward to deal with. With many braided cables it is not difficult to use your thumbnail to comb out the braiding, after which it can be treated just like lapped cable.

Where the braiding is thick and tightly woven the correct method of stripping it is to remove the outer insulation, fold over the inner with the braid, make a "hole" between the conductors in the braid on the outside of the fold using a small screwdriver, without breaking the conductors, and then pull out the inner. The braid can then be squeezed together and tinned ready for connection.

If a screened cable has a metal foil, the exposed foil is simply torn away. The connections are always made to the wire screens, not the foils which are far too insubstantial.

Constructional Project

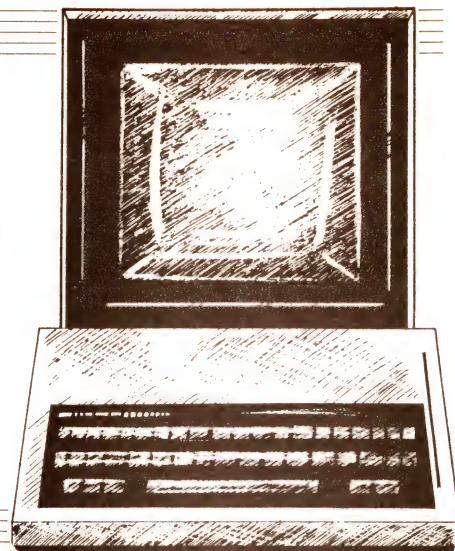
VERSATILE

BBC COMPUTER

INTERFACE

MARK STUART

Field tested in schools, this single-board interface allows up to 16 outputs, via relays etc., to be controlled by the BBC model B home computer.



THIS BBC Interface project is based on a design that has been supplied to schools for some time. It was originally designed to allow a standard BBC model B computer to control motors and solenoids and to read relays, switches and other input sensors in a classroom environment.

Eight output lines and eight programmable input/output lines are provided by using the User Port and parallel Printer Port. All sixteen possible outputs can be fitted with relays if required. Care was taken to protect the computer from externally connected power supplies and components so that pupils could be given as much freedom as possible to make their own circuits and test them under computer control.

In the course of its development a number of additional features were added, including l.e.d. indicators for the input and output states, plug-in relays, and inverted logic levels for the user port to prevent relays being operated by I/O lines set as inputs.

Standard IDC leads are used to make the connections to the computer. These are fitted to the interface board using soldered in connectors so that they cannot be "borrowed" for other jobs – a feature that will be appreciated by all involved in technology teaching. Connections to the inputs and outputs are made via p.c.b. mounted terminal blocks with internal wire protection springs which will tolerate reasonable usage and can be replaced individually if necessary.

CIRCUIT DETAILS

The circuit diagram of the Printer Port section is shown in Fig 1 and the User Port section in Fig. 2. Fig. 3 shows the BBC model B internal connections to the two ports and the pin connections to the 20-way and 26-way IDC connectors.

The Printer Port provides a latched TTL logic level output from a standard tri-state buffer i.c. (74LS244 - see Fig. 3). The outputs from this can be either logic "0" level, logic "1" level, or open circuit. The logic 1

condition is required to light the l.e.d. and operate the relay, both of the other conditions must have no effect.

The TTL output which is capable of supplying only a low current is amplified by a Darlington driver IC1 (Fig. 1) which has eight identical sections each capable of

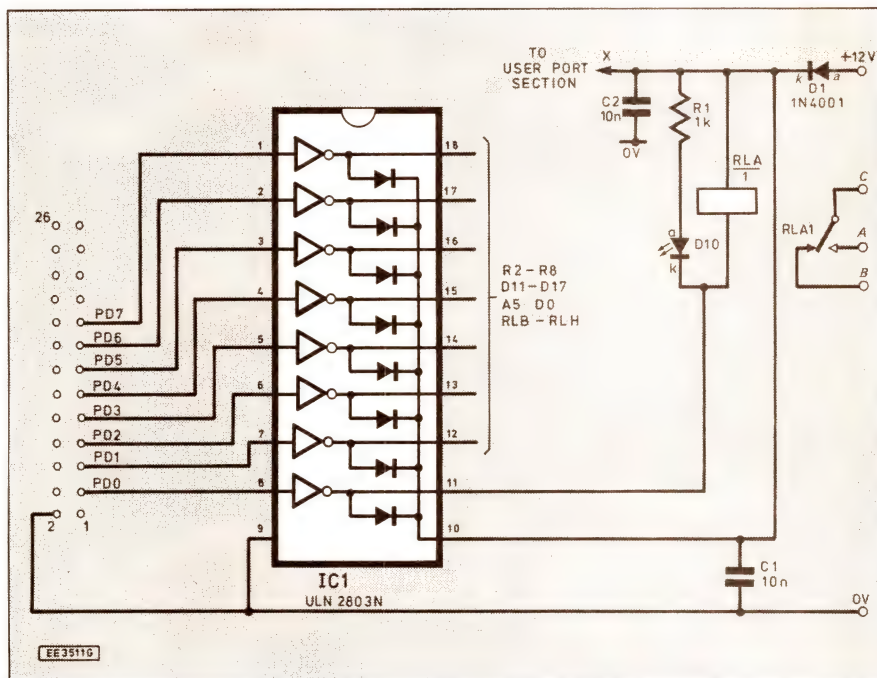
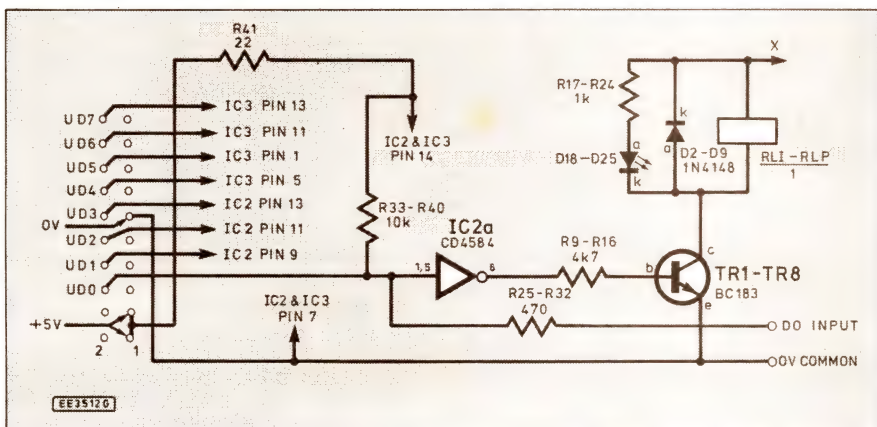


Fig. 1. Circuit diagram of the Printer Port section. The components, except C1, C2 and D1 are repeated for each output pin of IC1.

Fig. 2. Circuit diagram of the User Port section. The circuit is repeated for the buffers of IC2 and IC3, see Fig. 5.



switching 500mA at up to 50V. The internal circuit diagram of this i.c. is shown in Fig. 4.

Each output drives a relay RLA to RLH and an l.e.d. and series resistor, D10 to D17 and R1 to R8. Additional protection diodes are not required across the relay coils as they are included inside IC1.

Power to the relay coils and l.e.d.s is not taken from the computer, so an external 12V supply is required. This is connected via diode D1 to protect the circuit from reverse polarity. A small decoupling capacitor C1 removes any high frequency noise from the supply which might be coupled into the computer and cause problems.

The User Port section of the circuit is more complicated as it has to handle both inputs and outputs directly from the 6522

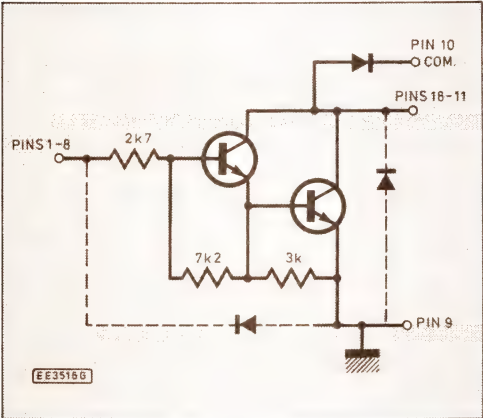


Fig. 4. Internal Darlington drive circuit for the ULN2803N i.c.

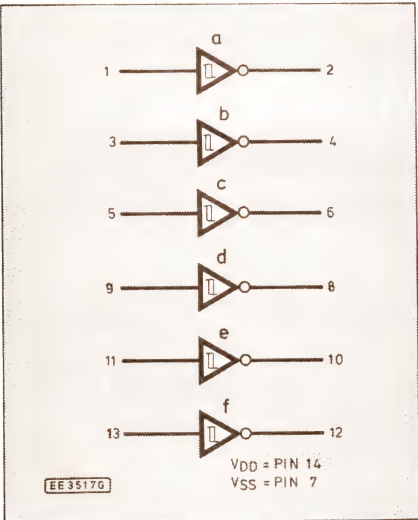


Fig. 5. Internal buffers of IC2 and IC3.

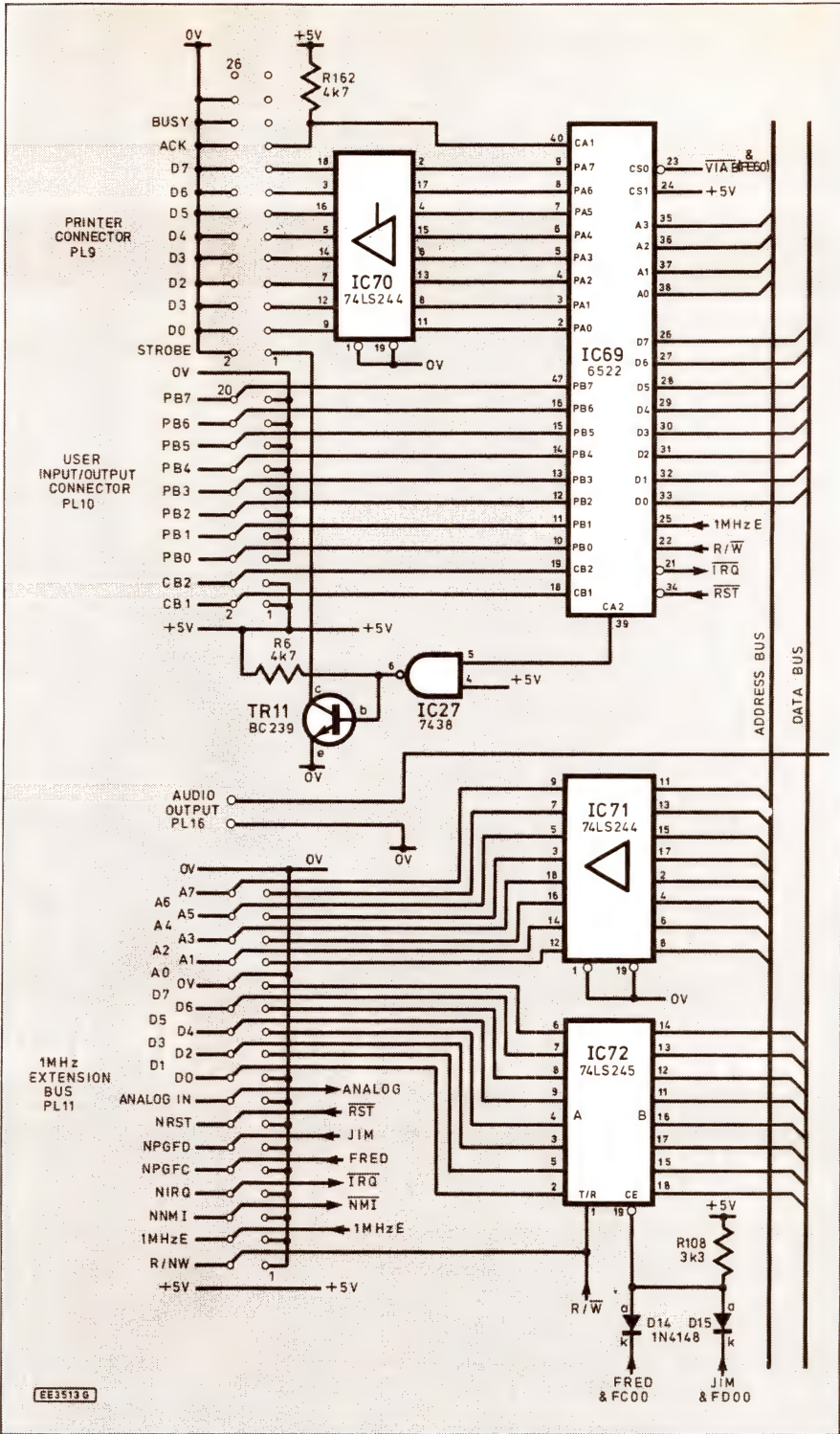
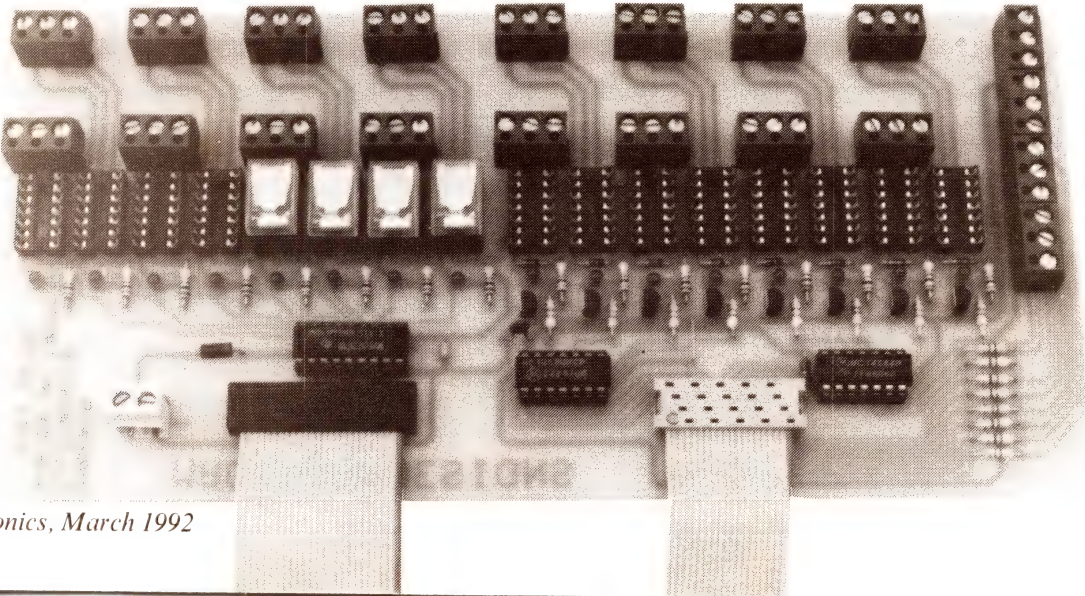


Fig. 3. Model B internal connections to the two ports and IDC connectors.



PIO i.c. in the computer. The outputs from the computer are amplified to drive relays via the CMOS Hexinverting buffers, contained in IC2 and IC3 and transistors TR1 to TR8. This arrangement is chosen because the CMOS buffers have negligible loading effect and so can remain connected to port lines which are programmed as inputs.

Unlike the Printer Port a logic 0 level is required to turn on the l.e.d. and operate the relay. This has been done because the User Port I/O lines float at logic 1 levels when not set as outputs. A situation which would result in all relays being energised upon switching on the computer until the control program could be loaded and run. As it is, switching the computer on leaves all l.e.d.s out and all relays released.

Each section of the CMOS buffer i.c.s drives the relevant transistor via a current limiting resistor R9 to R16. The relays RL1 to RLP are driven directly from these transistors and are powered from the external 12V supply. Diodes D2 to D9 are required across the relay coils to prevent high voltage spikes being generated as the relays are turned off. The l.e.d.s D18 to D25, fed via resistors R17 to R24, indicate the states of the lines.

The computer's 5V supply rail is used to power IC2 and IC3. Only a very small current is required. Limiting resistor R41 is connected in series with the supply to limit the potential short circuit current to a level that will not damage the computer.

Pull up resistors R33 to R40 hold the inputs of IC2 and IC3 high when the User Port lead is not connected to the computer, keeping all relays released and all l.e.d.s off. Without this the CMOS inputs float at random and cause the relays to chatter or operate when not required.

When the User port lines are programmed as inputs, resistors R33 to R40 have no effect because the inputs are already pulled up internally by the computer. Resistors R25 to R32 in series with each input limit the current that would otherwise flow if high voltages were to be applied.

The inputs work at standard logic levels based on 5V for a "1" and 0V for a "0". Up to 12V can be applied to each input without any harm being done.

As IC2 and IC3 are in circuit the logic levels on the inputs can be read on l.e.d.s D18 to D25, and if relays are left plugged in they will operate. It is best to decide which User port lines are being used as Inputs and Outputs and fit relays only in the Output positions.

CONSTRUCTION

The Versatile BBC Computer Interface is built on a single printed circuit board which also accommodates the p.c.b. plug-in relays. This board is available from the *EE PCB Service*, code EE787. The printed circuit board component layout and full size copper foil master pattern are shown in Fig. 6.

Begin by fitting all of the resistors, diodes, and the three wire links. The polarity of the diodes is marked by the band which indicates the cathode (k) end.

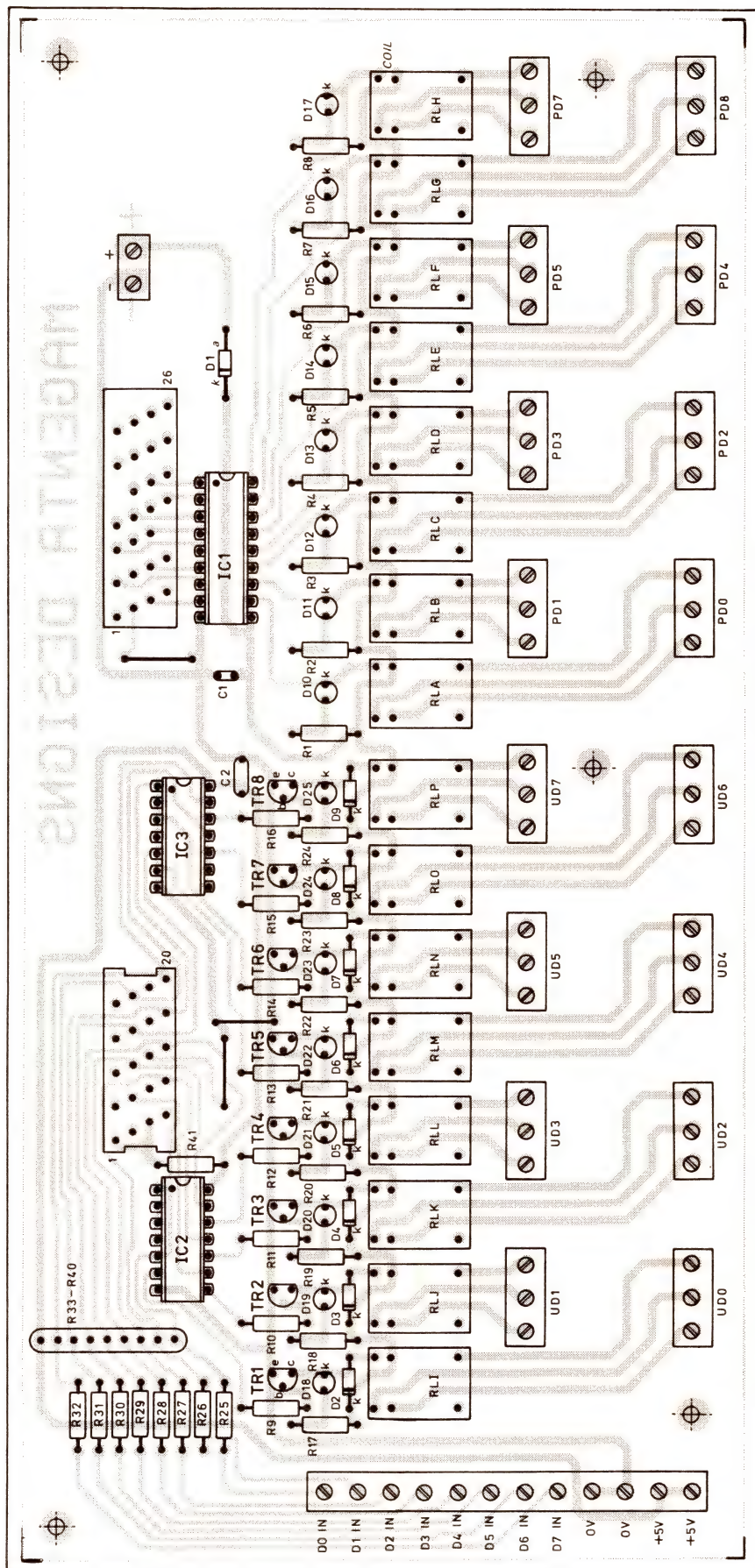
The relays fit into standard i.c. sockets but use only some of the pins. As the board is not drilled for the unused pins they must be removed or cut off before the sockets can be fitted. Some sockets have pins which can be pulled or pushed out easily. Take care to remove only the unwanted pins and to fit the sockets the same way round to

give a neat appearance. Sockets are also required for the i.c.s, and should be fitted with their polarity indicators (marking pin one) as shown.

The l.e.d.s should be fitted next with their shorter leads in the position marked "k" indicating the cathode connection. Be care-

ful to keep them flush to the board and in line, and not to overheat them during soldering. Now fit the transistors with their flat sides in the correct position and fit capacitors C1 and C2 either way round. The pull up resistors are in a resistor network R33 to R40. Note that the common

Fig. 6. Printed circuit board component layout and (right) full size copper foil master pattern.



end of this is marked with a dot which must be fitted nearest to the edge of the board.

The p.c.b. terminal blocks are of the type which dovetail together, four three-way ones must be joined for the input connectors, another sixteen being used individually for the relay connections and a two-way one for the 12V power connec-

tions. Make sure that these are pushed right into the board when soldering so that they are held firmly and resist moving when being used.

The final connections required are to the ribbon cable headers. These are available complete with assembled leads – see *Shop Talk* – which can be fitted and soldered di-

rectly to the board. If leads are to be made up, take care to fit the correct type of board transition connector and to fit it and the computer connector the right way round. This can be a baffling business and is not recommended except for experienced constructors. *

When assembly is complete insert the i.c.s in their sockets and thoroughly inspect the soldering for dry joints and solder bridges. Check that the correct resistor values have been fitted and the transistor types are correct, and the board is ready for testing.

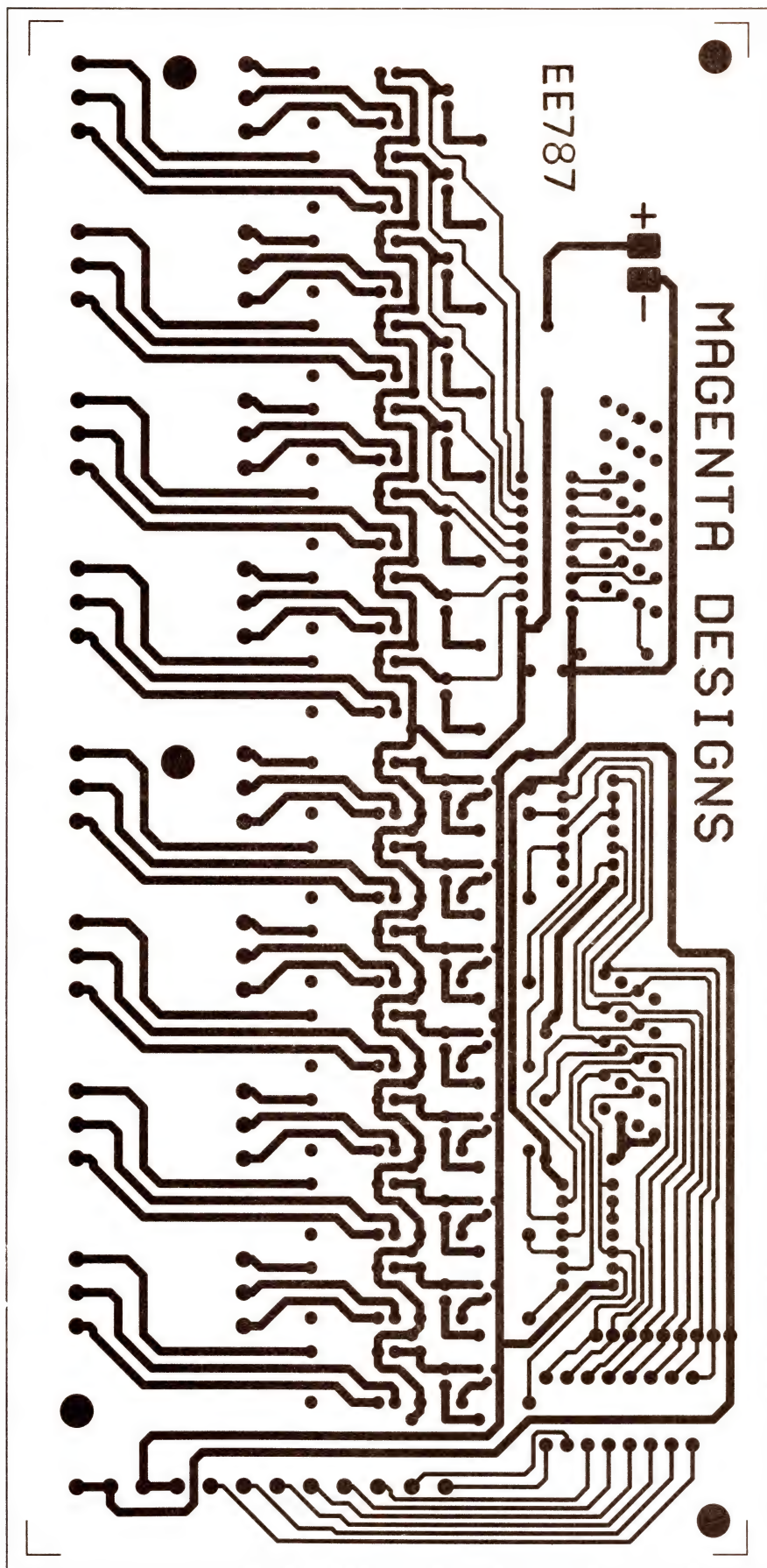
TESTING

Most of the tests can be carried out without a computer as the relays and l.e.d.s are powered from an external 12V supply. This can be any regulated or unregulated d.c. supply between 10V and 18V with 500mA rating.

Leave all relays and the computer connections out and connect the d.c. supply. All l.e.d.s should remain out and the circuit should draw very little current.

First test the Printer Port section. Connect a 1k resistor from pin one of IC1 to the incoming 12V supply and check that l.e.d. D17 lights. Fit a relay in RLH position and check that it operates and releases as the resistor is disconnected.

Repeat the test for IC1 pins two to eight and l.e.d.s D16 to D10 and relay positions RLG to RLA. Curious results should di-



COMPONENTS

Resistors

R1 to R8,	
R17 to R24	1k (16 off)
R9 to R16	4k7 (8 off)
R25 to R32	470 (8 off)
R33 to R40	10k x 8 SIL network
R41	22
All 0.25W 5% carbon, except resistor network R33 to R40.	

See
**SHOP
TALK**
Page

Capacitors

C1, C2	10nF ceramic plate, 50V (2 off)
--------	---------------------------------

Semiconductors

TR1 to TR8	BC183 npn silicon transistor (8 off)
D1	1N4001 1A 50V rec. diode
D2 to D9	1N4148 signal diode (8 off)
D10 to D25	TLUR5100 3mm Red diffused l.e.d. (16 off)
IC1	ULN2803N Octal Darlington driver array, TTL
IC2, IC3	CD4584 Hex Schmitt trigger (2 off)

Miscellaneous

RLA-RLP12V d.i.l. relay, with s.p.c.o. contacts (16 off).

Ribbon cable lead sets, 20-way female IDC to p.c.b. transition connector and 26-way female IDC to p.c.b. transition connector, both 0.5m long; 14-pin d.i.l. sockets (18 off); 18-pin d.i.l. socket; 3-way p.c.b. terminal block (20 off); 2-way p.c.b. terminal block; connecting wire; solder etc. Printed circuit board available from the *EE PCB Service*, code EE787.

Approx cost
guidance only

£52

rect attention to the appropriate section which should be inspected carefully.

The User Port section is more complicated as it requires a temporary connection of the 12V supply positive to power IC2 and IC3. This can be done by adding a link between the incoming 12V positive terminal and the end of resistor R41 nearer to the ribbon cable connector. The l.e.d.s should all remain out as this connection is made.

Link the input terminals to the 0V terminal one by one and the appropriate l.e.d. should light. Fit a relay into a socket and check that it operates and releases as expected. The connection and operation of the relay contacts can also be checked with a multimeter reading ohms.

When all of these tests have been completed the temporary 12V connection can be removed and the supply disconnected whilst the board is connected to a computer. It is wise to switch off the computer before connecting any type of peripheral and this is no exception. Once it is connected the computer can be switched on and off as required, as can the external 12V supply. The board is now ready for use with the computer.

PROGRAMMING

The Versatile BBC Computer Interface can be operated from within any program written by the user. The Printer Port is an output only port from which the interface is controlled by sending decimal numbers in the range 0 to 255 corresponding to

binary values of 00000000 to 11111111 or hexadecimal 00 to FF.

Using BBC BASIC on a computer fitted with OS 1.2 the printer port is operated as follows:

```
10 REM CLEAR PRINTER
  BUFFER
20 *FX21 3
30 INPUT "ENTER VALUE FOR
  OUTPUT PORT: "AS
40 A% = EVAL AS
50 REM SEND CODE TO
  PRINTER ONLY
60 VDU 2,1,A%,3
```

Line 20 makes sure that no unwanted codes are already in the printer buffer. Line 30 asks for an input string which is evaluated in line 40 and sent to the printer in line 60.

Line 60 starts with a 2 which enables the printer port, followed by 1 which directs the following code to the printer followed by the code (A%) and then a 3 which disables the printer. Only the key lines 20 and 60 may be needed when the program is incorporated into other programs, provided A is defined somewhere.

Operating the User Port section of the interface is different as both inputs and outputs can be accommodated. There is a considerable amount of information that has been published in EE and elsewhere and so only brief notes are given here.

There are two addresses of importance &FE62 and &FE60. The data direction (input or output) is set by the value loaded into &FE62. Loading 0 sets all eight data lines to the input state, whilst loading 255 sets all outputs. Any combination of the two can be set by the appropriate number, for example loading decimal 15 (hexadecimal 0F) sets the four upper data lines as inputs and the four lower lines as outputs. Output values are set and input values read from location &FE60.

Care is needed to make sure that the data is correctly interpreted by reading only the input data Bits and writing only to the output data Bits. Eliminating the unwanted Bits is achieved in the programming and is not difficult. Reading outputs

and writing to inputs causes confusion but cannot damage the interface or the computer.

The following simple program sets the User Port to all inputs and prints the incoming data value:

```
10 ?&FE62=0
20 X=?&FE60
30 PRINT X
40 GOTO 60
```

When this program is running the value printed should be 255 as all inputs are pulled up internally. Link the input terminals to negative one by one and the numbers will change, becoming zero when all inputs are connected to negative at the same time. Throughout this test the indicator l.e.d.s will light for each input connected to negative, and the corresponding relay (if fitted) will operate. As the port is only reading inputs the external 12V supply is not really necessary, and the computer will read accurate values either way. The l.e.d.s and relays will not operate, of course, without the 12V supply.

To operate the User Port as outputs the following program can be used. Note that the l.e.d.s are lit and relays operated by logic 0's and not 1's as discussed earlier.

```
10 ?&FE62=&FF
20 INPUT "ENTER VALUE FOR
  OUTPUT PORT: "AS
30 A% = EVAL AS
40 ?&FE60 = A%
```

This program begins by setting the port lines as outputs in line 10 and then prompts for a value which is loaded in line 40. Setting the outputs to 0 will light all l.e.d.s and close all relays.

From this the fuller operation of the Interface can be developed. Trial and error will soon produce results and it is a simple step to add a few switches to the inputs and motors to the outputs and enter the world of computer control. A separate power supply is recommended for motors etc. connected to the relay outputs, but it is possible to use batteries or to take the current from the existing 12V supply provided it is capable of supplying the necessary current.

USE

The outputs from the Interface are relatively easy to use as the relay contacts can be considered as simple switches. Fig. 7 shows the connection of a solenoid, with the necessary parallel protection diode, and Fig. 8 shows how two outputs can be connected to drive a reversible motor.

Inputs from photocells and opto-sensors are easily accommodated as shown in Fig. 9 which also shows the connection of a simple switch.

The BBC analogue input port is also available and can be incorporated into more elaborate control schemes, allowing analogue inputs from thermistors and photocells to be read and compared with pre-set values in the computer memory and used to drive output devices via the interface. In this way environmental control projects can be designed which control heating and ventilation in response to inside and outside temperatures, wind speed and direction, and time of day (derived from the computer real time clock).

The range of projects that can be built using this approach is practically endless, providing a new area use for BBC computers which in some applications are becoming rather outdated. □

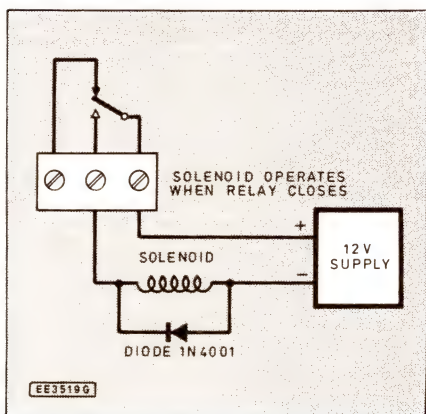


Fig. 7. Arrangement for driving a solenoid.

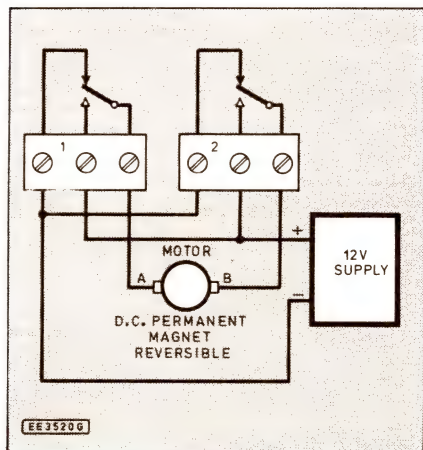


Fig. 8. Driving a reversible motor. When relay 1 contacts operate motor terminal A is positive and motor runs clockwise. When relay 2 contacts operate motor terminal B is positive and motor runs anticlockwise.

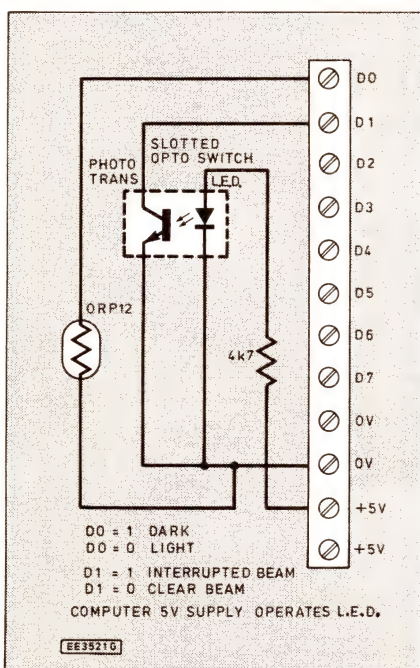


Fig. 9. Using an l.d.r. and an opto-transistor isolator to form a simple switch arrangement.

SHOP

TALK

with David Barrington

Emergency Plug Light

A couple of items required for the *Emergency Plug Light* project require further comment. Although several advertisers stock the plug type p.s.u. boxes these all seem to be of the wrong dimensions and, because of the tight fit of components, are not really suitable. The p.s.u. box used in the model was purchased from **Maplin**, code FG41U.

The choice of rating (250mA) for the mains transformer has deliberately been kept on the high side so that it runs cool in the confined space inside the case during operation. The one chosen was also obtained from the above company and is listed as: Miniature type 250mA Tr6V, code YN14Q.

The only source we have been able to locate for the "flat oblong type" thermal fuse type 891B 85°C is from **Omni Electronics** (☎ 031 667 2611). Once again due to space limitations, the fuse squeezes between the transformer windings and the case side, it is recommended that this type be used. The fuse is connected in series with the transformer live (brown) lead which also goes to the mains live pin on the plug section.

Economy Seven Timer

We do not expect any component buying problems to be encountered by readers undertaking the construction of the *Economy Seven Timer*. However, it is most important that due attention is paid to the rating of the switching relay and the "earthing" and/or insulation of the case.

It is important that the rating of the relay is not exceeded, the mains fuse should be rated so that the relay contacts cannot be overloaded by the appliance. The specified relay, which fits on the p.c.b., is the Ultra Miniature High Power type from **Maplin**, code YX97F.

The relay is rated at 10A a.c. (resistive) at 240V a.c. and 3A a.c. (inductive). Since a dishwasher and washing machine repre-

sents a mainly inductive load (the motor), the unit should NOT be used to switch an appliance rated at more than about 1kW with this relay.

The printed circuit board is available from the *EE PCB Service*, code EE788. Finally, the "Economy Seven" nighttime cheap rate switch over times seem to vary in differing areas, so you will have to check with your local authority.

Versatile BBC Interface

Some of the devices called for in the *Versatile BBC Interface* board may prove difficult to obtain. The diffused i.e.d., octal Darlington array i.c., relays and special lead sets are available from **Magenta Electronics**. Lead sets of this type are never cheap, but it might be worth asking about a "special price" if purchasing a "set" of sixteen relays.

A complete kit of parts (£51.95) including printed circuit board, relays and connecting lead sets is available from **Magenta Electronics**, Dept EE, 135 Hunter Street, Burton-on-Trent, Staffs, DE14 2ST (☎ 0283 65435). Add £2 for post and packing.

The printed circuit board is available from the *EE PCB Service*, code EE787 (see page 188).

Cycle Light Backup

We cannot foresee any component purchasing problems when ordering parts for the *Cycle Light Backup* project.

Plastic waterproof boxes, about the correct size, are available from most of our advertisers and cost around £3 each. Also available are waterproof toggle switch covers ranging from as much as £1.30 down to as little as 75p each. You can, of course, use any suitable plastic case and seal the lid joints with waterproof adhesive tape and fill the leadout and fixing holes with a suitable sealant.

You can use practically any relay, provided it will fit inside the case, sit on the strip-board (with an identical pin-out arrangement) and have similar electrical ratings.

Auto Garage Light

One or two points need highlighting for those about to undertake the construction of the *Auto Garage Light* project.

A 0.1in. (5.08mm) pitch layout is used throughout on the p.c.b. artwork. The use of metric pitch (5.00mm) components is unacceptable with this artwork (bad fit may strain the pins and enamelled copper wire leads on the transformer; if the transformer is not comfortably flush with the p.c.b. then the copper track may eventually lift away). The printed circuit board is available from the *EE PCB Service*, code EE 786 (see page 188).

Using p.c.b. mounting transformers is a real headache, because there is no standard configuration for the pin-outs. Different manufacturers all have their own style and the artwork may need changing if another device is used.

The prototype used a 3VA p.c.b. mounted mains transformer, made by OEP type G3809. This one is now discontinued by **Verospeed** and its replacement G3809E ("E" for encapsulated) won't fit because the pins are offset the other way.

The good news is that other types of transformer with imperial pitch are readily available which will fit the board. The RS, code 208-080, mains transformer from **Electromail** (☎ 0536 204555), is a 6VA type, which is more than enough for this application but will fit directly on the board. The same applies to the **Verospeed** (☎ 0703 644555) M1809E 6VA Encapsulated (code 289-51571D) or M1809 same, but open wound (code 289-51557E).

The relay used is available from **Maplin** (YX98G) or **Cirkit** (type OM1, part no. 46-70060). Ensure that a "back-to-back" device is used for the bicolour i.e.d., (e.g. **Maplin** QY83E).

It is most important that the BC184L transistor be used in the circuit and when placing your order for parts, make sure your supplier understands this.

Hot Tip

The soldering and de-soldering specialist Ungar has announced a special offer based on its ESD-safe, electronically-controlled 2110 solder station.

Not content with simply providing a value-for-money package (normally at just under £80) for a high performance station (tip leakage below 2mV, ceramic 60W 24V heater for rapid heat-up and adjustable temperature), they have decided to make their 2100 available on a three-for-the-price-of-two-basis, for a limited period only.

That's right: pay for two Ungar 2110 solder stations and they will send you three.

No, there isn't a catch: just write to them first for full details but act quickly, the offer won't last for ever.

UNGAR, Eldon Industries (UK) Ltd, Dept EE, Clifton Road, Sheffield, Beds SG17 5AB.

PLEASE TAKE NOTE

Mains Appliance Remote Control (MARC) Encoder. (July 1991)

The ML927 decoder i.c. (IC2) is no longer manufactured. This update suggests a modification to the MARC Encoder unit which will allow up to seven Decoders to be switched ON or OFF using the handheld IR remote unit. The UP/DOWN functions from the IR transmitter are no longer available, although full control can still be achieved via the opto-isolated 8-bit Encoder input port.

Modifications

- 1) Make sure that IC2 is *not* in its socket.
- 2) Cut the p.c.b. track between IC1 pin 8 and IC3 pin 11, but make sure resistor R13 remains connected to IC3 pin 11.
- 3) Solder a wire between IC1 pin 8 and IC4 pin 5.
- 4) Solder another wire between IC8 pin 1 and IC4 pin 2.

When a receiver number button between 1 and 7 on the transmitter is pressed, the relevant Decoder unit will switch OFF. If, however, button number 8 is pressed at the same time as the receiver number is pressed, then that Decoder will switch ON.

Example

Pressing '3' and '8' simultaneously will switch Decoder 3 ON
Pressing '3' on its own will switch Decoder 3 OFF.

It may be necessary to change capacitor C7 to a value of 150nF if difficulty is encountered controlling some Decoder units.





Fault Finding

My digital frequency meter developed an intermittent fault. On switching on it worked perfectly and then, quite suddenly, it either stopped working or produced an unstable reading; irritating.

I hate fault finding, so I shelved the problem until we went on our annual holiday to France. There, in what used to be the hayloft of a farmhouse, I have a work bench, and plenty of time. Starting with basics, I monitored the d.c. supply to the TTL logic. Nominally this was 5V, supplied from a mains unit (Fig. 1).

Low Voltage

Half an hour's monitoring produced one significant result. When the meter was working properly the stabilizer delivered 5V d.c. When the fault appeared the voltage dropped to 4V d.c.

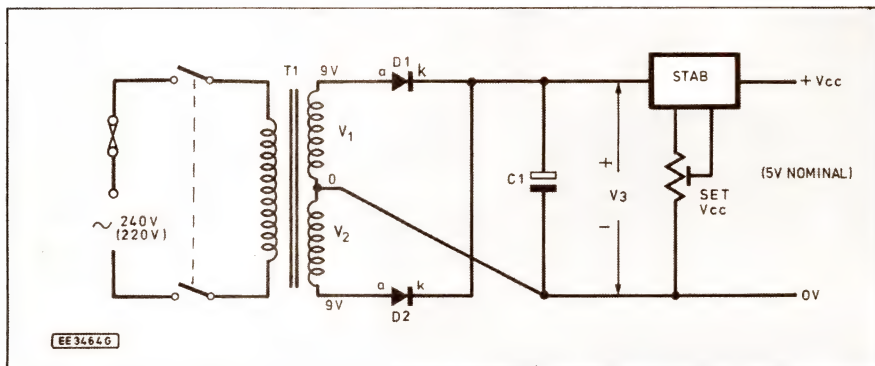


Fig. 1. Mains stabilised power unit circuit diagram.

Not a huge fall, but enough to upset TTL, which is fussy about supply voltage.

This was good news, because it suggested that the fault lay in the power supply unit (p.s.u.), which in principle was repairable, rather than in the digital part of the circuit board which, being full of soldered-in i.c.s, probably wasn't (with my limited equipment). The need was to track down the cause, doing the minimum amount of unsoldering in the process. The p.s.u. components were

also on the main p.c.b. and its copper tracks were thin and looked easily damageable.

Mains Supply

The trouble might be due to a varying mains voltage. If this were to fall too low there might not be enough d.c. to operate the stabilizer. French mains voltage is 220V a.c. Low (the nominal input required by the meter is 240V) but not that low. Monitoring showed that the 220V remained rock steady during periods when the meter was faulty, so the mains voltage couldn't be the real problem.

At this point there seemed to be several possibilities:

1. A faulty mains transformer, e.g. with an intermittent internal short.
2. Faulty stabilizer.
3. Faulty rectifiers.
4. Reservoir capacitor C1. A reduction in capacitance, due to some internal bad connection, might cause the d.c. voltage to fall. So might internal leakage, by imposing an extra current drain.
5. Something else, including poor connections such as cracked tracks on the p.c.b.

Problem, find out which. I had a good French dinner with a glass or two of red wine then slept on it.

Resistance measurements on the transformer windings gave stable readings. The rectifier diodes D1 and D2 are in parallel to d.c., because the low-resistance transformer secondary windings connects their anodes. Measuring with an ohmmeter gave normal results; conduction one way, no conduction the other way. But this didn't rule out the possibility of one rectifier being open-circuit.

The capacitor showed no abnormally low leakage resistance, on my ohmmeter, but since the applied voltage in this test is low the result wasn't conclusive.

Waveforms

Time to take a closer look, with something more revealing than a voltmeter. An oscilloscope gave the waveforms shown

number of turns a greater length of wire is needed, so the resistance is greater. This could account for the unequal ripple waveforms, though they looked a bit too unequal to me.

It was, in fact, the ripple that provided the decisive clue. Under fault conditions (right hand column) the ripple frequency was halved (V3). One diode was not conducting. Rectification had changed from full-wave (push-pull) to half-wave. The half-secondary voltages showed which. During a fault, V2 no longer had flattened peaks, so its associated winding was not delivering pulses of current; diode D2 was faulty; or badly connected.

Thermal Effects

Replacing D2 cured the trouble. The ripple voltage became more even and the rectified voltage increased, but what was wrong with the original D2? An ohmmeter test said it was OK. Infinite reverse resistance, low forward resistance.

I left the ohmmeter across it, showing the forward resistance. When the diode was warmed with a soldering iron the resistance dithered, rose, and finally became very high. Thermal expansion was evidently pulling the diode apart.

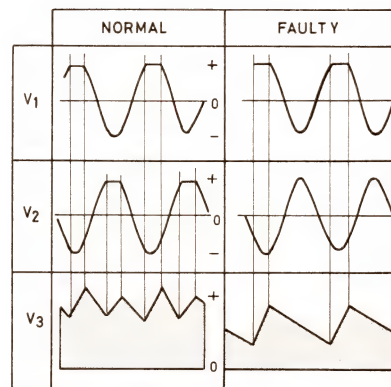


Fig. 2. Waveforms obtained from the power unit using an oscilloscope.

Safety First

While I was congratulating myself on a neat bit of detective work (*Elémentaire, mon cher Watson*) I noticed that the digital meter was giving the wrong reading. It can be set to measure period as well as frequency, and I'd been using the stepped-down 50Hz mains voltage as a handy test signal. The period should be 20 milliseconds; the meter range selected gave this in tens of microseconds. The normal reading was then 2000 ± 1 , but I was now getting 2005.

I knew that the mains frequency in France doesn't vary; it's crystal-controlled. So the timing oscillator in my meter must be running fast. A sudden thought made me switch off quickly. Earlier, I'd turned up the voltage control on the stabilizer, in an attempt to get the correct V_{cc} . I hadn't turned it down, and now it was perhaps dangerously high and wrecking the TTL chips.

In fact it was only 5.2V, but this apparently was enough to upset the oscillator. Readjusting to 5V restored the status quo. But my carelessness could have been disastrous. A shaking experience, necessitating calming treatment. *Encore du vin rouge, s'il vous plaît, chérie.*

SURVEILLANCE PROFESSIONAL QUALITY KITS

No. 1 for Kits

Whether your requirement for surveillance equipment is amateur, professional or you are just fascinated by this unique area of electronics SUMA DESIGNS has a kit to fit the bill. We have been designing electronic surveillance equipment for over 12 years and you can be sure that all of our kits are very well tried, tested and proven and come complete with full instructions, circuit diagrams, assembly details and all high quality components including fibreglass PCB. Unless otherwise stated all transmitters are tuneable and can be received on an ordinary VHF FM radio.

UTX Ultra-miniature Room Transmitter

Smallest room transmitter kit in the world! Incredible 10mm x 20mm including mic. 3-12V operation. 500m range.....£16.45

MTX Micro-miniature Room Transmitter

Best-selling micro-miniature Room Transmitter
Just 17mm x 17mm including mic. 3-12V operation. 1000m range.....£13.45

STX High-performance Room Transmitter

Hi performance transmitter with a buffered output stage for greater stability and range. Measures 22mm x 22mm including mic. 6-12V operation, 1500m range.....£15.45

VT500 High-power Room Transmitter

Powerful 250mW output providing excellent range and performance. Size 20mm x 40mm. 9-12V operation. 3000m range.....£16.45

VXT Voice Activated Transmitter

Triggers only when sounds are detected. Very low standby current. Variable sensitivity and delay with LED indicator. Size 20mm x 67mm. 9V operation. 1000m range.....£19.45

HVX400 Mains Powered Room Transmitter

Connects directly to 240V AC supply for long-term monitoring. Size 30mm x 35mm. 500m range.....£19.45

SCRX Subcarrier Scrambled Room Transmitter

Scrambled output from this transmitter cannot be monitored without the SCDM decoder connected to the receiver. Size 20mm x 67mm. 9V operation. 1000m range.....£22.95

SCLX Subcarrier Telephone Transmitter

Connects to telephone line anywhere, requires no batteries. Output scrambled so requires SCDM connected to receiver. Size 32mm x 37mm. 1000m range.....£23.95

SCDM Subcarrier Decoder Unit for SCRX

Connects to receiver earphone socket and provides decoded audio output to headphones. Size 32mm x 70mm. 9-12V operation.....£22.95

ATR2 Micro Size Telephone Recording Interface

Connects between telephone line (anywhere) and cassette recorder. Switches tape automatically as phone is used. All conversations recorded. Size 16mm x 32mm. Powered from line.....£13.45

UTLX Ultra-miniature Telephone Transmitter

Smallest telephone transmitter kit available. Incredible size of 1mm x 20mm! Connects to line (anywhere) and switches on and off with phone use. All conversation transmitted. Powered from line. 500m range.....£15.95

TLX700 Micro-miniature Telephone Transmitter

Best-selling telephone transmitter. Being 20mm x 20mm it is easier to assemble than UTLX. Connects to line (anywhere) and switches on and off with phone use. All conversations transmitted. Powered from line. 1000m range.....£13.45

STLX High-performance Telephone Transmitter

High performance transmitter with buffered output stage providing excellent stability and performance. Connects to line (anywhere) and switches on and off with phone use. All conversations transmitted. Powered from line. Size 22mm x 22mm. 1500m range.....£16.45

TKX900 Signalling/Tracking Transmitter

Transmits a continuous stream of audio pulses with variable tone and rate. Ideal for signalling or tracking purposes. High power output giving range up to 3000m. Size 25mm x 63mm. 9V operation.....£22.95

CD400 Pocket Bug Detector/Locator

LED and piezo bleeper pulse slowly, rate of pulse and pitch of tone increase as you approach signal. Gain control allows pinpointing of source. Size 45mm x 54mm. 9V operation.....£30.95

CD600 Professional Bug Detector/Locator

Multicolour readout of signal strength with variable rate bleeper and variable sensitivity used to detect and locate hidden transmitters. Switch to AUDIO CONFORM mode to distinguish between localised bug transmission and normal legitimate signals such as pagers, cellular, taxis etc. Size 70mm x 100mm. 9V operation.....£50.95

QTX180 Crystal Controlled Room Transmitter

Narrow band FM transmitter for the ultimate in privacy. Operates on 180 MHz and requires the use of a scanner receiver or our QRX180 kit (see catalogue). Size 20mm x 67mm. 9V operation. 1000m range.....£40.95

QLX180 Crystal Controlled Telephone Transmitter

As per QTX180 but connects to telephone line to monitor both sides of conversations. 20mm x 67mm. 9V operation. 1000m range.....£40.95

QXS180 Line Powered Crystal Controlled Phone Transmitter

As per QLX180 but draws power requirements from line. No batteries required. Size 32mm x 37mm. Range 500m.....£35.95

QRX180 Crystal Controlled FM Receiver

For monitoring any of the 'Q' range transmitters. High sensitivity unit. All RF section supplied as a pre-built and aligned module ready to connect on board so no difficulty setting up. Outpt to headphones. 60mm x 75mm. 9V operation.....£60.95

A build-up service is available on all our kits if required.

UK customers please send cheques, POs or registered cash. Please add £1.50 per order for P&P. Goods despatched ASAP allowing for cheque clearance. Overseas customers send sterling bank draft and add £5.00 per order for shipment. Credit card orders welcomed on 0827 714476.

OUR LATEST CATALOGUE CONTAINING MANY MORE NEW SURVEILLANCE KITS NOW AVAILABLE. SEND TWO FIRST CLASS STAMPS OR OVERSEAS SEND TWO IRCS.

★★★ Specials ★★★

DLTX/DLRX Radio Control Switch

Remote control anything around your home or garden, outside lights, alarms, paging system etc. System consists of a small VHF transmitter with digital encoder and receiver unit with decoder and relay output, momentary or alternate, 8-way di1 switches on both boards set your own unique security code. TX size 45mm x 45mm. RX size 35mm x 90mm. Both 9V operation. Range up to 200m.

Complete System (2 kits).....£50.95
Individual Transmitter DLTX.....£19.95
Individual Receiver DLRX.....£37.95

MBX-1 Hi-Fi Micro Broadcaster

Not technically a surveillance device but a great idea! Connects to the headphone output of your Hi-Fi, tape or CD and transmits Hi-Fi quality to a nearby radio. Listen to your favourite music anywhere around the house, garden, in the bath or in the garage and you don't have to put up with the DJ's choice and boring waffle. Size 27mm x 60mm. 9V operation. 250m range.....£20.95

**SUMA
DESIGNS**

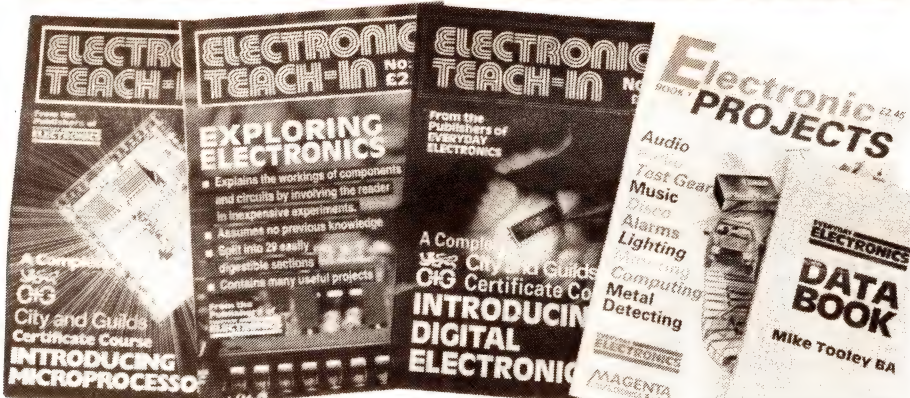
DEPT. EE
THE WORKSHOPS, 95 MAIN ROAD,
BAXTERLEY, NEAR ATERSTONE,
WARWICKSHIRE CV9 2LE

VISITORS STRICTLY BY APPOINTMENT ONLY



0827 714476

SPECIAL EVERYDAY ELECTRONICS BOOKS



ELECTRONICS TEACH-IN 88/89 - INTRODUCING MICROPROCESSORS

Mike Tooley BA (published by *Everyday Electronics*)
A complete course that can lead successful readers to the award of a City and Guilds Certificate in Introductory Microprocessors (726/303). The book contains everything you need to know including full details on registering for assessment, etc.

Sections cover Microcomputer Systems, Micro-processors, Memories, Input/Output, Interfacing and Programming. There are various practical assignments and eight Data Pages covering the most popular microprocessor chips.

An excellent introduction to the subject even for those who do not wish to take the City and Guilds assessment.
80 pages (A4 size) **Order code TI-88/89 £2.45**

ELECTRONIC PROJECTS BOOK 1

Published by *Everyday Electronics* in association with *Magenta Electronics*.

Contains twenty of the best projects from previous issues of *EE* each backed with a kit of components. The projects are: Seashell Sea Synthesiser, EE Treasure Hunter, Mini Strobe, Digital Capacitance Meter, Three Channel Sound to Light, BBC 16K sideways Ram, Simple Short Wave Radio, Insulation Tester, Stepper Motor interface, Eprom Eraser, 200MHz Digital Frequency Meter, Infra Red Alarm EE Equaliser

Ioniser, Bat Detector, Acoustic Probe, Mainstester and Fuse Finder, Light Rider - (Lapel Badge, Disco Lights, Chaser Light), Musical Doorbell, Function Generator, Tilt Alarm, 10W Audio Amplifier, EE Buccaneer Induction Balance Metal Detector, BBC Midi Interface, Variable Bench Power Supply, Pet Scarer, Audio Signal Generator.
128 pages (A4 size) **Order code EP1 £2.45**

ELECTRONICS TEACH-IN No. 3 - EXPLORING ELECTRONICS (published by *Everyday Electronics*)

Owen Bishop
Another *EE* value for money publication aimed at students of electronics. The course is designed to explain the workings of electronic components and circuits by involving the reader in experimenting with them. The book does not contain masses of theory or formulae but straightforward explanations and circuits to build and experiment with.

Exploring Electronics contains more than 25 useful projects, assumes no previous knowledge of electronics and is split into 28 easily digestible sections.
88 pages (A4 size) **Order code T13 £2.45**

ELECTRONICS TEACH-IN No. 4 - INTRODUCING DIGITAL ELECTRONICS (published by *Everyday Electronics*)

Michael J. Cockcroft
Although this book is primarily a City & Guilds Introductory level course (726/301), approximately 80% of the informa-

tion forms a very basic introduction to electronics in general, it therefore provides an excellent introductory text for beginners and a course and reference book for GCSE students.

Full details on registering for C&G assessment, details of assessment centres, components required and information on the course in general are given.

The City & Guilds introduction to module 726/301 reads: "A candidate who satisfactorily completes this module will have a competence to identify basic components and digital integrated circuits and connect them together to form simple working circuits and logic units." This provides an excellent introduction to the book.
112 pages (A4 size) **Order code T14 £2.95**

ELECTRONICS TEACH-IN No. 5 GUIDE TO BUILDING ELECTRONIC PROJECTS

Published by *Everyday Electronics*
Due to the demand from students, teachers and hobbyists we have put together a range of articles from past issues of *Everyday Electronics* that will assist those involved with the construction of electronic projects.

The book contains the complete *Project Development* for GCSE series.

Contents: Features - First Steps in Project Building; Building with Vero; Project Development for GCSE; Getting your Projects Working; Guide to Printed Circuit Boards; Choosing and Using Test Equipment - The Multimeter, The Oscilloscope, P.S.U.s, Logic Probes, Digital Frequency Meters, Signal Generators, etc; **Data** - Circuit Symbols; Component Codes; Resistors; Identifying Components; Capacitors; Actually Doing It - Understanding the Circuit Diagram, Component Codes, Mounting circuit boards and controls, Understanding Capacitors; **Projects** - Lie Detector; Personal Stereo Amplifier; Digital Experimenters' Unit; Quizmaster; Siren Effects Unit; UV Exposure Unit; Low-cost Capacitance Meter; Personal Radio.
88 pages (A4 size) **Order code T15 £2.95**

EVERDAY ELECTRONICS DATA BOOK

Mike Tooley BA
(published by *EE* in association with *PC Publishing*)

This book is an invaluable source of information of everyday relevance in the world of electronics. It contains not only sections which deal with the essential theory of electronic circuits, but it also deals with a wide range of practical electronic applications.

It is ideal for the hobbyist, student, technician and engineer. The information is presented in the form of a basic electronic recipe book with numerous examples showing how theory can be put into practice using a range of commonly available "industry standard" components and devices.

A must for everyone involved in electronics!
256 pages **Order code DATA £8.95**

DIRECT BOOK SERVICE

The books listed have been selected by *Everyday Electronics* editorial staff as being of special interest to everyone involved in electronics and computing. They are supplied by mail order direct to your door. Full ordering details are given on the last book page. For another selection of books see next month's issue

ELECTRONIC TEST EQUIPMENT HANDBOOK

Steve Money

The principles of operation of the various types of test instrument are explained in simple terms with a minimum of mathematical analysis. The book covers analogue and digital meters, bridges, oscilloscopes, signal generators, counters, timers and frequency measurement. The practical uses of the instruments are also examined.

Everything from Audio oscillators, through R, C & L measurements (and a whole lot more) to Waveform Generators and testing Zeners. A truly comprehensive book for the hobbyist, student, technician and engineer.
206 pages **Order code PC109 £8.95**

HOW TO TEST ALMOST EVERYTHING

ELECTRONIC - 2nd Edition

Jack Darr and Delton T. Horn

Describes electronic tests and measurements - how to make them with all kinds of test equipment, and how to interpret the results. New sections in this edition include logic probes, frequency counters, capacitance meters, and more. (An American book.)
190 pages **Order code T2925 £9.05**

GETTING THE MOST FROM YOUR MULTIMETER

R. A. Penfold

This book is primarily aimed at beginners and those of limited experience of electronics. Chapter 1 covers the basics of analogue and digital multimeters, discussing the relative merits and the limitations of the two types. In Chapter 2 various methods of component checking are described, including tests for transistors, thyristors, resistors, capacitors and diodes. Circuit testing is covered in Chapter 3, with subjects such as voltage, current and continuity checks being discussed.

In the main little or no previous knowledge or experience is assumed. Using these simple component and circuit testing techniques the reader should be able to confidently tackle servicing of most electronic products.
96 pages **Order code BP239 £2.95**

MORE ADVANCED USES OF THE MULTIMETER

R. A. Penfold

This book is primarily intended as a follow-up to BP239, (see above), and should also be of value to anyone who already understands the basics of voltage testing and simple component testing. By using the techniques described in chapter 1 you can test and analyse the performance of a range of components with just a multimeter

TESTING, THEORY AND REFERENCE

(plus a very few inexpensive components in some cases). Some useful quick check methods are also covered.

While a multimeter is supremely versatile, it does have its limitations. The simple add-ons described in chapter 2 extended the capabilities of a multimeter to make it even more useful. The add-ons described include an active r.f. probe, a high resistance probe, an a.c. sensitivity booster, and a current tracer unit.
84 pages **Order code BP265 £2.95**

THE ILLUSTRATED DICTIONARY OF ELECTRONICS - 4th Edition

Rufus P. Turner and Stan Gibilisco

With more than 27,000 terms used in electronics today, this collection is THE most comprehensive dictionary available. Including all practical electronics and computer terms, it is up-to-date as the latest advances in the field itself. Tables and data on subjects most often consulted for projects and experiments are included. Other conversion tables include English/metric and metric/English conversions for units of energy, power and volume, and Fahrenheit/Celsius temperature conversion charts.

Setting this edition apart from other electronic dictionaries is its emphasis on illustration. Featuring more than complete definitions, this fourth edition includes over 450 detailed drawings and diagrams.

All entries are listed in alphabetical order. Abbreviations and initials are listed in sequence with whole words. All terms of more than one word are treated as one word. (An American book.)
648 pages **Temporarily out of print**

ELECTRONICS - A "MADE SIMPLE" BOOK

G. H. Olsen

This book provides excellent background reading for our *Introducing Digital Electronics* series and will be of interest to everyone studying electronics. The subject is simply explained and well illustrated and the book assumes only a very basic knowledge of electricity.
330 pages **Order code NE10 £4.95**

PRACTICAL ELECTRONICS CALCULATIONS AND FORMULAE

F. A. Wilson, C.G.I.A., C.Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.

Bridges the gap between complicated technical theory, and "cut-and-try" methods which may bring success in design but leave the experimenter unfulfilled. A strong

practical bias - tedious and higher mathematics have been avoided where possible and many tables have been included.

The book is divided into six basic sections: Units and Constants, Direct-current Circuits, Passive Components, Alternating-current Circuits, Networks and Theorems, Measurements.
256 pages **Order code BP53 £3.95**

PRACTICAL DIGITAL ELECTRONICS

HANDBOOK

Mike Tooley (Published in association with *Everyday Electronics*)

The vast majority of modern electronic systems rely heavily on the application of digital electronics, and the *Practical Digital Electronics Handbook* aims to provide readers with a practically based introduction to this subject. The book will prove invaluable to anyone involved with the design, manufacture or servicing of digital circuitry, as well as to those wishing to update their knowledge of modern digital devices and techniques. Contents: Introduction to integrated circuits; basic logic gates; monostable and bistable devices; timers; microprocessors; memories; input and output devices; interfaces; microprocessor buses. Appendix 1: Data. Appendix 2: Digital test gear projects; tools and test equipment; regulated bench power supply; logic probe; logic pulser; versatile pulse generator; digital IC tester; current tracer; audio logic tracer; RS-232C breakout box; versatile digital counter/frequency meter. Appendix 3: The oscilloscope. Appendix 4: Suggested reading. Appendix 5: Further study.
208 pages **Order code PC100 £6.95**

ELECTRONICS-BUILD AND LEARN

R. A. Penfold

The first chapter gives full constructional details of a circuit demonstrator unit that is used in subsequent chapters to introduce common electronic components - resistors, capacitors, transformers, diodes, transistors, thyristors, fets and op amps. Later chapters go on to describe how these components are built up into useful circuits, oscillators, multivibrators, bistables and logic circuits.

At every stage in the book there are practical tests and experiments that you can carry out on the demonstrator unit to investigate the points described and to help you understand the principles involved. You will soon be able to go on to more complex circuits and tackle fault finding logically in other circuits you build.
120 pages **Order code PC103 £5.95**

AUDIO AND MUSIC

LOUDSPEAKERS FOR MUSICIANS

NEW

Vivian Capel

This book contains all that a working musician needs to know about loudspeakers; the different types, how they work, the most suitable for different instruments, for cabaret work, and for vocals. It gives tips on constructing cabinets, wiring up, when and where to use wadding, and when not to, what fittings are available, finishing, how to ensure they travel well, how to connect multi-speaker arrays and much more.

Ten practical enclosure designs with plans and comments are given in the last chapter, but by the time you've read that far you should be able to design your own!

164 pages **Order code BP297** £3.95

MAKE MONEY FROM HOME RECORDING

Clive Brooks

Now that you've spent a fortune on all that recording gear, MIDI and all, wouldn't it be nice to get some of it back? Well here's the book to show you how.

It's packed with money making ideas, any one of which will recoup the price of the book many times over. Whether you have a fully fledged recording studio at home, or just a couple of stereo cassette recorders and a microphone, you'll be able to put the ideas in this book into practice and make money.

105 pages **Order code PC104** £5.95

INTRODUCTION TO DIGITAL AUDIO

(Second Edition)

Ian Sinclair

Digital recording methods have existed for many years and have become familiar to the professional recording engineer, but the compact disc (CD) was the first device to bring digital audio methods into the home. The next step is the appearance of digital audio tape (DAT) equipment.

All this development has involved methods and circuits that are totally alien to the technician or keen amateur who has previously worked with audio circuits. The principles and practices of digital audio owe little or nothing to the traditional linear circuits of the past, and are much more comprehensible to today's computer engineer than the older generation of audio engineers.

This book is intended to bridge the gap of understanding for the technician and enthusiast. The principles and methods are explained, but the mathematical background and theory is avoided, other than to state the end product.

128 pages **Order code PC102** £6.95

SYNTHESIZERS FOR MUSICIANS

R. A. Penfold

Modern synthesizers are extremely complex, but they mostly work on principles that are not too difficult to

understand. If you want to go beyond using the factory presets or the random poking of buttons, this is the book for you.

It covers the principles of modern synthesis – linear arithmetic as used by Roland, phase distortion (Casio), Yamaha's frequency modulation, and sampling – and then describes how the instruments are adjusted to produce various types of sound – strings, brass, percussion, etc. The theoretical side of synthesis is treated in an easy to understand way – the technical information being restricted to what you need to know to use your instrument effectively.

168 pages **Order code PC105** £6.95

AUDIO

F. A. Wilson, C. G. I. A., C. Eng., F.I.E.E., F.I.E.R.E., F.B.I.M.

Analysis of the sound wave and an explanation of acoustical quantities prepare the way. These are followed by a study of the mechanism of hearing and examination of the various sounds we hear. A look at room acoustics with a subsequent chapter on microphones and loudspeakers then sets the scene for the main chapter on audio systems – amplifiers, oscillators, disc and magnetic recording and electronic music.

320 pages **Order code BP111** £3.95

CIRCUITS AND DESIGN

REMOTE CONTROL HANDBOOK

Owen Bishop

Remote control systems lend themselves to a modular approach. This makes it possible for a wide range of systems, from the simplest to the most complex, to be built up from a number of relatively simple modules. The author has tried to ensure that, as far as possible, the circuit modules in this book are compatible with one another. They can be linked together in many different configurations to produce remote control systems tailored to switch a table lamp on and off, or to operate an industrial robot, this book should provide the circuit you require.

226 pages **Order code BP240** £3.95

COIL DESIGN AND CONSTRUCTION MANUAL

B. B. Babani

A complete book for the home constructor on "how to make" RF, IF, audio and power coils, chokes and transformers. Practically every possible type is discussed and calculations necessary are given and explained in detail. Although this book is now rather old, with the exception of torroids and pulse transformers little has changed in coil design since it was written.

96 pages **Order code 160** £2.50

30 SOLDERLESS BREADBOARD PROJECTS – BOOK 1

R. A. Penfold

Each project, which is designed to be built on a "Vero-bloc" breadboard, is presented in a similar fashion with a brief circuit description, circuit diagram, component layout diagram, components list and notes on construction and use where necessary. Whenever possible, the components used are common to several projects, hence with only a modest number of reasonably inexpensive components, it is possible to build in turn, every project shown. Recommended by BICC-Vero.

160 pages **Order code BP107** £2.95

BOOK 2 –

All projects use CMOS i.c.s. but the items on component identification etc., are not repeated from Book 1.

160 pages **Order code BP113** £2.25

ELECTRONIC CIRCUITS HANDBOOK

Michael Tooley BA

This book aims to explode two popular misconceptions concerning the design of electronic circuits: that only those with many years of experience should undertake circuit design and that the process relies on an understanding of advanced mathematics. Provided one is not too ambitious, neither of these popularly held beliefs is true.

Specifically, this book aims to provide the reader with a unique collection of practical working circuits together with supporting information so that circuits can be produced in the shortest possible time and without recourse to theoretical texts.

Furthermore, information has been included so that the circuits can readily be modified and extended by readers to meet their own individual needs. Related circuits have been grouped together and cross-referenced within the text (and also in the index) so that readers are aware of which circuits can be readily connected together to form more complex systems. As far as possible, a common range of supply voltages, signal levels and impedances has been adopted.

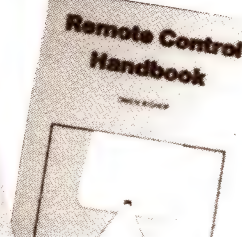
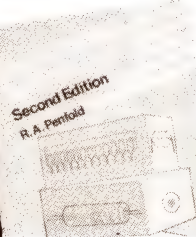
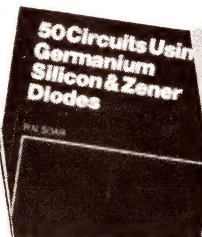
As a bonus, ten test gear projects have been included. These not only serve to illustrate the techniques described but also provide a range of test equipment which is useful in its own right.

277 pages **Order code NE05** £16.95

AUDIO IC CIRCUITS MANUAL

R. M. Marston

A vast range of audio and audio-associated i.c.s. are readily available for use by amateur and professional design engineers and technicians. This manual is a guide to the most popular and useful of these devices, with over 240 diagrams. It deals with i.c.s. such as low frequency linear amplifiers, dual pre-amplifiers, audio power amplifiers, charge coupled device delay lines, bar-graph display drivers, and power supply regulators, and shows how to use these devices in circuits ranging



from simple signal conditioners and filters to complex graphic equalizers, stereo amplifier systems, and echo/reverb delay line systems etc.

168 pages **Order code NE13** £12.95

HOW TO DESIGN ELECTRONIC PROJECTS

R. A. Penfold

The aim of this book is to help the reader to put together projects from standard circuit blocks with a minimum of trial and error, but without resorting to any advanced mathematics. Hints on designing circuit blocks to meet your special requirements are also provided.

128 pages **Order code BP127** £2.25

50 CIRCUITS USING GERMANIUM SILICON AND ZENER DIODES

R. N. Soar

Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most simple and inexpensive of components – the diode. Includes the use of germanium and silicon signal diodes, silicon rectifier diodes and Zener diodes, etc.

64 pages **Order code BP36** £1.95

DESIGNING WITH LINEAR ICs

G. C. Loveday

A book that deals with the design of the vital area of analog circuitry covering design with modern linear integrated circuit devices. The first chapter introduces the reader to important design techniques, test strategies, layout, and protection and also includes a section on the use of a typical CAD tool. There are separate chapters that cover in depth the use of op-amps, comparators and timers each with detailed design examples and reader exercises. A final chapter brings all the previous work together in a number of complete design problems with fully worked solutions. The text is essentially non-mathematical and is supported by many diagrams.

64 pages **Order code BP36** **Special Price £6.95**

TIMER/GENERATOR CIRCUITS MANUAL

R. M. Marston

This manual is concerned mainly with waveform generator techniques and circuits. Waveform generators are used somewhere or other in most types of electronic equipment, and thus form one of the most widely used classes of circuit. They may be designed to produce outputs with sine, square, triangle, ramp, pulse, staircase, or a variety of other forms. The generators may produce modulated or unmodulated outputs, and the outputs may be of single or multiple form.

Waveform generator circuits may be built using transistors, op-amps, standard digital ICs, or dedicated waveform or "function" generator ICs.

The manual is divided into eleven chapters, and presents over 300 practical circuits, diagrams and tables. The subjects covered include: Basic principles; Sine wave generators; Square wave generators; Pulse generator circuits; "Timer IC" generator circuits; Triangle and sawtooth generators; Multi-waveform generation; Waveform synthesizer ICs; Special waveform generators; Phaselocked loop circuits; Miscellaneous "555" circuits.

267 pages **Order code NE18** £12.95

OPTOELECTRONICS CIRCUITS MANUAL

R. M. Marston

A useful single-volume guide to the optoelectronics device user, specifically aimed at the practical design engineer, technician, and the experimenter, as well as the electronics student and amateur. It deals with the subject in an easy-to-read, down-to-earth, and non-mathematical yet comprehensive manner, explaining the basic principles and characteristics of the best known devices, and presenting the reader with many practical applications and over 200 circuits. Most of the i.c.s. and other devices used are inexpensive and readily available types, with universally recognised type numbers.

182 pages **Order code NE14** £12.95

POPULAR ELECTRONIC CIRCUITS – BOOK 1

POPULAR ELECTRONIC CIRCUITS – BOOK 2

R. A. Penfold

Each book provides a wide range of designs for electronic enthusiasts who are capable of producing working projects from just a circuit diagram without the aid of detailed construction information. Any special setting-up procedures are described.

BOOK 1 160 pages **Order code BP80** £2.95

BOOK 2 160 pages **Order code BP98** £2.95

CMOS CIRCUITS MANUAL

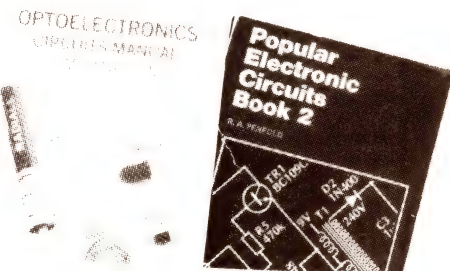
R. M. Marston

Written for the professional engineer, student or enthusiast. It describes the basic principles and characteristics of these devices and includes over 200 circuits.

All the circuits have been designed, built and fully evaluated by the author; all use inexpensive and internationally available devices.

187 pages **Order code NE12** £12.95

Note – our postage charge is the same for one book or one hundred books!



PROJECT CONSTRUCTION

HOW TO DESIGN AND MAKE YOUR OWN P.C.B.s

R. A. Penfold

Deals with the simple methods of copying printed circuit board designs from magazines and books and covers all aspects of simple p.c.b. construction including photographic methods and designing your own p.c.b.s. 80 pages

Order code BP121 £2.50

HOW TO GET YOUR ELECTRONIC PROJECTS WORKING

R. A. Penfold

We have all built projects only to find that they did not work correctly, or at all, when first switched on. The aim of this book is to help the reader overcome just these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.

96 pages

Order code BP110 £2.50

ELECTRONIC SCIENCE PROJECTS

O. Bishop

These projects range in complexity from a simple colour temperature meter to an infra-red laser. There are novelties such as an electronic clock regulated by a resonating spring, and an oscilloscope with solid-state display. There are scientific measuring instruments such as a pH meter and an electro-cardiometer. All projects have a strong scientific flavour. The way they work, and how to build and use them are fully explained.

144 pages

Order code BP104 £2.95

BEGINNER'S GUIDE TO BUILDING ELECTRONICS PROJECTS

R. A. Penfold

Shows the complete beginner how to tackle the practical side of electronics, so that he or she can confidently build the electronic projects that are regularly featured in

magazines and books. Also includes examples in the form of simple projects.

112 pages

Order code Z27

£1.95

TEST EQUIPMENT CONSTRUCTION

R. A. Penfold

This book describes in detail how to construct some simple and inexpensive but extremely useful, pieces of test equipment. Stripboard layouts are provided for all designs, together with wiring diagrams where appropriate, plus notes on construction and use.

The following designs are included:- AF Generator, Capacitance Meter, Test Bench Amplifier, AF Frequency Meter, Audio Millivoltmeter, Analogue Probe, High Resistance Voltmeter, CMOS Probe, Transistor Tester, TTL Probe. The designs are suitable for both newcomers and more experienced hobbyists.

104 pages

Order code BP248

£2.95

DATA AND COMPONENT IDENTIFICATION

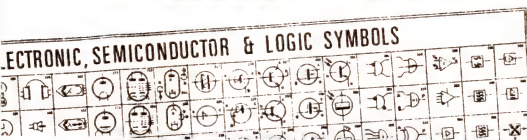


CHART OF RADIO, ELECTRONIC, SEMICONDUCTOR AND LOGIC SYMBOLS

M. H. Banani B.Sc.(Eng.)

Illustrates the common, and many of the not-so-common, radio, electronic, semiconductor and logic symbols that are used in books, magazines and instruction manuals, etc., in most countries throughout the world.

Chart

Order code BP271

£0.95

INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE

A. Michaels

Helps the reader to find possible substitutes for a popular selection of European, American and Japanese transistors. Also shows material type, polarity, manufacturer and use.

320 pages

Order code BP85

£3.95

RADIO, TV, SATELLITE

SETTING UP AN AMATEUR RADIO STATION

I. D. Poole

The aim of this book is to give guidance on the decisions which have to be made when setting up any amateur radio or short wave listening station. Often the experience which is needed is learned by one's mistakes, however, this can be expensive. To help overcome this, guidance is given on many aspects of setting up and running an efficient station. It then proceeds to the steps that need to be taken in gaining a full transmitting licence.

Topics covered include: The equipment that is needed; Setting up the shack; Which aerials to use; Methods of construction; Preparing for the licence.

An essential addition to the library of all those taking their first steps in amateur radio

86 pages

Order code BP300

£3.95

BEGINNER'S GUIDE TO RADIO - 9th EDITION

Gordon J. King

Radio signals, transmitters, receivers, antennas, components, valves and semiconductors, CB and amateur radio.

266 pages

Order code NE08

£6.95

AN INTRODUCTION TO RADIO DXING

R. A. Penfold

Anyone can switch on a short wave receiver and play with the controls until they pick up something, but to find a particular station, country or type of broadcast and to receive it as clearly as possible requires a little more skill and knowledge. The object of this book is to help the reader to do just that, which in essence is the fascinating hobby of radio DXing.

112 pages

Order code BP91

£1.95

EXPERIMENTAL ANTENNA TOPICS

H. C. Wright

Although nearly a century has passed since Marconi's first demonstration of radio communication, there is still research and experiment to be carried out in the field of antenna design and behaviour.

The aim of the experimenter will be to make a measurement or confirm a principle, and this can be done with relatively fragile, short-life apparatus. Because of this, devices described in this book make liberal use of cardboard, cooking foil, plastic bottles, cat food tins, etc. These materials are, in general, cheap to obtain and easily

worked with simple tools, encouraging the trial-and-error philosophy which leads to innovation and discovery.

Although primarily a practical book with text closely supported by diagrams, some formulae which can be used by straightforward substitution and some simple graphs have also been included.

72 pages

Order code BP278

£3.50

NEWNES SHORTWAVE LISTENING HANDBOOK

Joe Pritchard G1UQW

Part One covers the "science" side of the subject, going from a few simple electrical "first principles", through a brief treatment of radio transmission methods to simple receivers. The emphasis is on practical receiver designs and how to build and modify them, with several circuits in the book.

Part Two covers the use of sets, what can be heard, the various bands, propagation, identification of stations, sources of information, QSLing of stations and listening to amateurs. Some computer techniques, such as computer Morse decoding and radio teletype decoding are also covered.

224 pages

Order code NE16

£14.95

COMPUTING

SERVICING PERSONAL COMPUTERS - 2nd EDITION

Mike Tooley BA

The revised and enlarged second edition contains a new chapter on the IBM PC, AT, TX and compatibles. It is essential for anyone concerned with the maintenance of personal computer equipment or peripherals, whether professional service technician, student or enthusiast.

240 pages (Hard cover)

Order code NE15

£25

HOW TO EXPAND, MODERNISE AND REPAIR PCs AND COMPATIBLES

R. A. Penfold

Not only are PC and compatible computers very expandable, but before long most users actually wish to take advantage of that expandability and start upgrading their PC systems. Some aspects of PC upgrading can be a bit confusing, but this book provides advice and guidance on the popular forms of internal PC expansion, and should help to make things reasonably straightforward and painless. Little knowledge of computing is assumed. The only assumption is that you can operate a standard PC of some kind (PC, PC XT, PC AT, or a 80386 based PC).

The subjects covered include: PC overview; Memory upgrades; Adding a hard disk drive; Adding a floppy disk drive; Display adaptors and monitors; Fitting a maths co-processor; Keyboards; Ports; Mice and digitisers; Maintenance (including preventative maintenance) and Repairs, and the increasingly popular subject of d.i.y. PCs.

156 pages

Order code BP271

£4.95

AN INTRODUCTION TO PROGRAMMING THE BBC MODEL B MICRO

R. A. & J. W. Penfold

Written for readers wanting to learn more about programming and how to make best use of the incredibly powerful model B's versatile features. Most aspects of the BBC Micro are covered, the omissions being where little could usefully be added to the information provided by the manufacturer's own manual.

144 pages

Order code BP139

£1.95

AN INTRODUCTION TO 6502 MACHINE CODE

R. A. & J. W. Penfold

No previous knowledge of microprocessors or

machine code is assumed. Topics covered are: assembly language and assemblers, the register set and memory, binary and hexadecimal numbering systems, addressing modes and the instruction set, and also mixing machine code with BASIC. Some simple programming examples are given for 6502-based home computers like the VIC-20, ORIC-1/Atmos, Electron, BBC and also the Commodore 64.

112 pages

Order code BP147

£2.95

The PRE-BASIC BOOK

F. A. Wilson, C.G.I.A., C.ENG., F.I.E.E., F.I.E.R.E., F.B.I.M.

Another book on BASIC but with a difference. This one does not skip through the whole of the subject and thereby leave many would-be programmers floundering but instead concentrates on introducing the technique by looking in depth at the most frequently used and more easily understood computer instructions. For all new and potential micro users.

192 pages

Order code BP146

£2.95

DIRECT BOOK SERVICE ORDERING DETAILS

Please state the title and order code clearly, print your name and address and add the required postage to the total order.

Add 75p to your total order for postage and packing (overseas readers add £1.50 for countries in Europe, or add £2.50 for all countries outside Europe, surface mail postage) and send a PO, cheque, international money order (£ sterling only) made payable to **Direct Book Service** or credit card details (including card expiry date), Visa or Mastercard (Access) - minimum credit card order is £5 - quoting your name and address, the order code and quantities required to DI-

RECT BOOK SERVICE, 33 GRAVEL HILL, WIMBORNE, DORSET BH21 1RW (mail order only).

Although books are normally sent within seven days of receipt of your order, please allow a maximum of 28 days for delivery. Overseas readers allow extra time for surface mail post.

Please check price and availability (see latest issue of *Everyday Electronics*) before ordering from old lists.

Note - our postage charge is the same for one book or one hundred books!

MORE BOOKS NEXT MONTH

DIRECT BOOK SERVICE IS A DIVISION OF WIMBORNE PUBLISHING LTD.

F.J.P. KITS & COMPONENTS

Kit Manufacturers - Amateur Radio Products

PROPRIETOR: F. POWELL

63, Princess Street, Chadsmoor, Cannock, Staffs WS11 2JT
Telephone: 0543 506487

We at F.J.P. KITS have been supplying radio/electronic kits for quite a long time, we stock most ITEMS from a nut & bolt to sophisticated ICs. The kits we supply are quite complete, where possible. Just a few items we stock: boxes, Plastic, aluminium, Rack casings, ICs in depth, transistors, diodes, kits, METERS, Transformers. All goods offered are of good quality and brand new, we do not stock old surplus. Illustrated catalogue £1 PO or stamps, cheques to F. POWELL.

No VAT to add MAIL ORDER ONLY FAST FRIENDLY service

CAPACITORS ceramic plate 5p, 2.5mm pitch. **ELECTROLYTIC** 1µF to 100µF 25/16V, 8p ea. Mini radial, 35/40V 10p. **POLYESTER** box 5mm pitch:- 1n to 10n, 47n etc 5p, 22n-100n 6p, 470n 12p, 63V mini, 250V radial all 1 price to clear 5p ea. inc 160V, 400V 12p.
POLYSTYRENE 63V/250V plus minis, 100p to 10n all 1 price 10p.
RESISTORS 5% E24 1/4 watt 1R to 10 meg 1p ea. or 70p per 100 off any mix.
RESISTORS 1/3 watt or 1/2 watt E24 1R-10meg 2p or 85p per 100 even values i.e. 10 per value.
RESISTORS wirewound 2.5watt 1 + 27p, 10 +, 25p, 4 watt 30p + value, 7 watt 38p + value.
TANTALUM BEAD CAPS RADIAL: 0.1 to 10µF/25/35V 15p, 47µF 16V 35p, 22µF 16V 25p, etc.
DIODES 1N4148/1N914 3p. 1N400 series 5p up to 1N4006. 1N4007 8p. Diodes 1N5400 series 1N5408 1kV 14p. Others 3 amp in these 12p.
TRANSISTORS. BC107-9 metal can 12p. BC237-9 9p, BC182-4 and L series 10p. BFY50 25p. BFX88 25p, 2N3055 with mics/bushes 60p.
FULL RANGE OF FETS, R.F. transistors available e.g. 2N3189 35p, MPF102 45p, J309-10 60p. Full range of Plessey ICs.
TOOLS HELPING HANDS Glass magnifier £5.95, Plastic lenses £4.00, wire snips £2.50p.
VICE mini table/clamp vice £3.95/P/P £1.00. Heavy. **PLIERS POINTED** long £3.50 shrt £1.50.
VOLTAGE REGULATORS 1.5 amp. 5V, 8V, 12V, 15V 35p, LM337 1.5A variable 75p, LM723 55p.
VOLTAGE REGULATORS 100mA T092 case 5V, 6V, 8V, 12V, 15V, 24V, 30p ea.
IC SOCKETS from 6p 8-pin, to 40-pin 25p.
MAINS INDICATOR (NEON with resistor) 10p. Clip on test clips 35p red/bk pair.
PP/SNAPS PP3 9p. PP9 12p. DRY batts PP3 @ 35p.
KITS EE. TRANSISTOR TESTER BOXED KIT (Less P.C.B.) Batts inc. £34.00 inc. of P/P.
EE Jan '92 MICRO SENSE ALARM KIT inc box, (Less P.C.B.) £27.50p inc P/P.

REMEMBER we stock CMOS ICs, FAST TTL, LINEAR, R.F. ICs TOKO products, MIRATA, etc.

TERMS ACCESS/VISA min order £5, or CHEQUE/P.O. payable to F. POWELL.

DELIVERY 1-7 days on components, 3-14 days on kits.

We can supply any kit for **EE** (Less P.C.B.s) if we have the details, at prices you can afford.

POSTAL RATES: Over £5 none; Under £5 add 30p on small orders, i.e. few bits. Transformers, BOXES £1.00.



New for 1992

★ New MOSFET Amplifiers

improved range of SMOS modules
30W, 30+30W, 60W, 120W

★ 20 watt Class A Amplifier

★ Low profile PCB Transformers

a range of encapsulated transformers
4VA, 6VA, 10VA, 18VA, 24VA, 30VA

Write or phone for data and prices...
which include details of standard range of
toroidal transformers and audio modules.

No price increase for 1992

Jaytee Electronic Services

143 Reculver Road, Beltinge, Herne Bay, Kent CT6 6PL
Telephone: (0227) 375254. Fax: (0227) 365104

Typefit

THE TYPESETTING BUREAU LTD

PC page make-up software and typesetter output bureau

*"For serious document production it
knocks other DTP software into
the proverbial cocked hat."*

Those are the words of Jim Tyler, an independent journalist after reviewing Typefit for "Micro Computer Mart". His letter to us went on to say:

"I spent two years editing a magazine, I have been involved in running a DTP bureau and I currently make my living writing classic car restoration manuals for a division of Reed Business International. I would choose Typefit for any of these roles."

No we did not pay him anything – he did not even get a free copy of our software (Typefit only costs £225 + VAT anyway). And just for the sceptics he is not a personal friend, relative or shareholder in the company.

His sentiments are backed up by our customers, some of which have changed from other well-known DTP packages costing much more – they tell us Typefit is more

versatile and provides them with use of a better range of quality typefaces (230 different fonts).

With Typefit you do your own Typesetting, proof and correct your work, we provide the expensive phototypesetter and fonts to give you top quality 2000 dot per inch bromide output.

Before investing in any other DTP package and especially before spending a small fortune on a specialist typesetting computer or other equipment, please investigate Typefit.

Please send me more information on Typefit

Name.....

Address:.....

.....Post Code.....

Tel:.....EE3

We do have older boards in stock – please enquire.

PROJECT TITLE	Order Code	Cost
MARC Phone-In FEB'91	721	£6.87
Teach-In '91 Part 3 – TBA820M Amplifier	723	£4.05
High Quality Power Amp	724	£4.93
Bench Amplifier (Teach-In '91 Project 3)	725	£4.45
Gingernut 80m Receiver		
R.F. section (726), Voltage Regulator (727)	726/7/8	£3.06
Audio Amplifier (728)	all 3 together	per board £8.16
Pocket Tone Dialler MAR'91	729	£4.36
Battery To Mains Inverter	730	£4.97
Simple Basic Alarm	731	£4.50
Car Code Lock (pair)	732a/b	£4.69
Teach-In '91 Part 4 – Sinusoidal Oscillator	733	£4.39
8038 Oscillator	734	£4.15
Waveform Generator (Teach-In '91 Project 4)	735	£4.72
Humidity Tester APR'91	716	£4.97
Model Train Controller (double-sided)	736	£9.75
Electronic Die (Teach-In '91 Project 5)	737	£4.93
Teach-In '91 Part 5 – Digital Counter Module	738	£4.35
Modular Disco Lighting System MAY'91		
Switched Power Output Module	739	£5.91
Digital LCD Thermostat–Control Board } £5 for pair	740	£4.05
–Power/Relay Board }	741	£3.76
Pulse Generator (Teach-In '91 Project 6)	742	£4.97
Teach-In '91 Part 6– Timer Module	743	£4.62
Digilogue Car Tachometer JUN'91	744	£5.63
Modular Disco Lights – Simple Chaser	745	£5.00
Sweeper Module	746	£5.17
Automatic Light Control – PSU Board	747	£4.88
Logic Board	748	£5.17
Radio Receiver (Teach-In '91 Project 7)	749	£4.57
Teach-In '91 Part 7 – R.F. Amplifier Module	750	£4.23
Modular Disco Lights – Masterlink JULY'91	752	£6.36
Ultrasonic Proximity Meter		
Display Unit (753) & Sensor Unit (754)	753/754	£7.06
Disco Lights (Teach-In '91 Project 8)		
PSU and Pre-amplifier	755	£4.54
Low, Mid, High Filter/Triac (set of 3 boards)	756	£11.00
Teach-In '91 Part 8 – Solid State Switch Module	757	£4.24
Mod. Disco Lights – Pattern Gen AUG'91	760	£6.79
Teach-In '91 Part 8–Light Sensitive Switch	761	£4.74
Opto-Link (Teach-In '91 Project 9) – Transmitter	762	£4.85
Receiver	763	£4.88
Portable PEST Scarer	764	£3.77
Capacitance Meter SEP'91	751	£5.17
Modular Disco Lights – Dimmer Interface	765	£8.17
Mod. Disco Lights OCT'91		
VU Sound Module (Double-sided)	767	£8.68
UV Exposure Unit	768	£4.63
PC-Scope Interface – Main Board	769	£6.95
Expansion Plug (Double-sided)	770	£5.96
Mod. Disco Lights NOV'91		
Superchaser (Double-sided)	771	£6.91
Supersweep (Double-sided)	772	£8.26
Bicycle Alarm	773	£5.01
Darts Scorer	774	£7.90
Knockerbox DEC'91	775	£5.35
Signal Generator – Main Board	776	£7.46
PSU	777	£4.73
Mind Machine – Main Board	778	£7.00
Auto Nightlight	779	£5.03
Mind Machine – Programmer Board JAN'92	780	£7.39
Transistor Checker	781	£4.63
Stepping Motor Driver/Interface	782	£10.39
Micro- Sense Alarm	783	£5.42
Telesound FEB'92	EE784	£4.66
Programmable Timer	EE785	£4.63
Auto Garage Light MAR'92	786	£6.10
Versatile BBC Computer Interface	787	£11.59
Economy Seven Timer	788	£5.20

[illegible]

Carbon Film resistors 1/4W 5% E24 series 0.51 R to 10MΩ	1p
100 off per value - 75p, even hundreds per value totalling 1000	£6.00p
Metal Film resistors 1/4W 10R to 1 MΩ 5% E12 series - 2p. 1% E24 series	3p
Mixed metal/carbon film resistors 1/4W E24 series 1R0 to 10MΩ	1 1/2p
1 watt mixed metal/carbon film 5% E12 series 4R7 to 10 Megohms	5p
Linear Carbon pre-sets 100mW and 1/4W 100R to 4M7 E6 series	7p
Miniature polyester capacitors 250V working for vertical mounting	
015, 022, 033, 047, 068-4p 0.1 - 5p. 0.12, 0.15, 0.22 - 6p. 0.47 - 8p. 0.68 - 8p. 1.0 - 12p	
Mylar (polyester) capacitors 100V working E12 series vertical mounting	
1000p to 8200p - 3p. 0.01 to 0.68 - 4p. 0.1 - 5p. 0.12, 0.15, 0.22 - 6p. 0.47/50V - 8p	
Submin ceramic plate capacitors 100V wkg vertical mountings. E12 series	
2% 1.8pf to 47pf - 3p. 2% 56pf to 330pf - 4p. 10% 390p-4700p	4p
Disc/plate ceramics 50V E12 series 1P0 to 1000P, E6 Series 1500P to 47000P	2p
Polystyrene capacitors 63V working E12 series long axial wires	
10pf to 820pf - 4p. 1000pf to 10,000pf - 5p. 12,000pf	6p
741 Op Amp - 20p. 555 Timer	22p
CMOS 4001 - 20p. 4011 - 22p. 4017	40p
ALUMINIUM ELECTROLYTICS (Mfds/Volts)	
1/50, 2.2/50, 4.7/50, 10/25, 10/50	5p
22/16, 22/25, 22/50, 47/16, 47/25, 47/50	6p
100/16, 100/25 7p; 100/50 12p; 100/100	14p
220/16 8p; 220/25, 220/50 10p; 470/16, 470/25	11p
1000/25 25p; 1000/35, 2200/25 35p; 4700/25	70p
Submin. tantalum bead electrolytics (Mfds/Volts)	
0.1/35, 0.22/35, 0.47/35, 1.0/35, 3.3/16, 4.7/16	14p
2.2/35, 4.7/25, 4.7/35, 6.8/16 15p; 10/16, 22/6	20p
33/10, 47/6, 22/16 30p; 47/10 35p; 47/16 60p; 47/35	80p
VOLTAGE REGULATORS	
1A + or - 5V, 8V, 12V, 15V, 18V & 24V - 55p. 100mA 5.8, 12, 15, V +	30p
DIODES (piv/amps)	
75/25mA 1N4148 2p. 800/1A 1N4006 4p. 400/3A 1N5404 14p. 115/15mA OA91	8p
100/1A 1N4002 3p. 1000/1A 1N4007 5p. 60/1.5A S1M1 5p. 100/1A bridge	25p
400/1A 1N4004 4p. 1250/1A BY 127 10p. 30/15A OA47	10p
Zener diodes E24 series 3V3 to 33V 400mW - 8p. 1 watt	12p
Battery snaps for PP3 - 6p for PP9	12p
L.E.D.'s 3mm, & 5mm. Red, Green, Yellow - 10p. Grommets 3mm - 2p. 5mm	2p
Red flashing L.E.D.'s require 9-12V supply only	50p
Mains indicator neons with 220k resistor	10p
20mm fuses 100mA to 5A. O. blow 5p A/surge 10p. Holders, chassis, mounting	6p
High speed pc drill 0.8, 1.0, 1.3, 1.5, 2.0mm - 30p. Machines 12V dc	£7.00
HELPING HANDS 6 ball joints and 2 croc clips to hold awkward jobs	£3.50p
AA/HP7 Nicad rechargeable cells 90p each. Universal charger unit	£6.50p
Glass reed switches with single pole make contacts - 8p. Magnets	12p
0.1" Stripboard 2 1/2" x 1" 9 rows 25 holes - 25p. 3 1/2" x 2 1/2" 24 rows 37 holes	70p
Jack plugs 2.5 & 3.5m	14p
Sockets Panel Mtg 2.5 & 3.5m	10p
TRANSISTORS	
BC107/8/9 - 12p. BC547/8/9 - 8p. BC557/8/9 - 8p. BC182, 182L, BC183, 183L	
BC184, 184L, BC212, 212L - 10p.	
BC327, 337, 337L - 12p. BC727, 737 - 12p. BD135/6/7/8/9 - 25p. BCY70 - 18p.	
BFY50/51/52 - 20p.	
BFX88 - 15p. 2N3055 - 50p. TIP31, 32 - 30p. TIP41, 42 - 40p. BU208A - £1.20. BF195, 197 - 12p	
lonisers with seven year guarantee, list price £16.95	£12.00

All prices are inclusive of VAT. Postage 30p (free over £5). Lists Free.

THE CR SUPPLY CO
127 Chesterfield Rd., Sheffield S8 0RN
Tel: 0742 557771 Return posting

NEW FROM HIGH-Q 30 VELLEMAN KITS

Added To Our Range

NOW "130" KITS AVAILABLE
For all Electronic Enthusiasts

Sole UK Importers • Trade Enquiries contact below

NEW KITS INCLUDE:

CODELOCK

CAR ACCESSORIES

CAR ALARM

COUNTERS

DIMMERS

POWER SUPPLIES

AUDIO

TIMERS

HOUSEHOLD APPLICATIONS

SENSORS

DIGITAL CONTROLLED PRE-AMPLIFIER

COMMUNICATIONS

1-CHANNEL INFRA-RED RECEIVER

ALARMS

LIGHT-EFFECTS

COMPUTER INTERFACE

GADGETS

MEASURING DEVICES

15-CHANNEL INFRA-RED TRANSMITTER

For 1991 Catalogue & Price List, please sent 75p (UK)
or £2.00 (Overseas) to:

HIGH-Q-ELECTRONICS

VISA

P.O. BOX 142, Hatfield, Herts AL9 7JH

Tel: 0707 263562

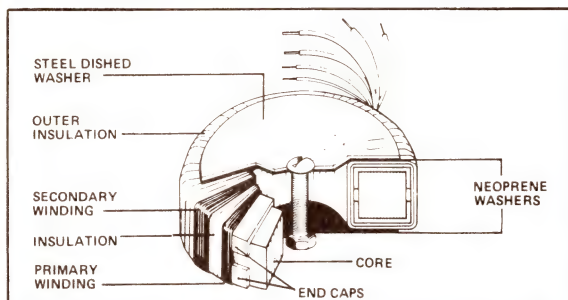
Fax: 0707 276746



The UK Distributor for Standard Toroidal Transformers

* 106 types available from stock

* Sizes from 15VA to 625VA



Write or phone for free Data Pack

Jaytee Electronic Services

143 Reculver Road, Beltinge, Herne Bay, Kent CT6 6PL

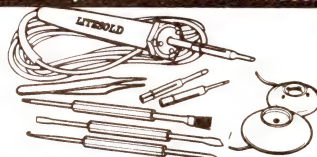
Telephone: (0227) 375254

JOIN UP WITH LITESOLD

Professional Soldering Equipment at Special Mail-Order Prices.

SK18 Soldering Kit. £17.28

Build or repair any electronic project.
LC18 240v 18w iron with 3.2, 2.4,
and 1.6mm bits. Pack of 18 swg
flux-cored 60/40 solder. Tweezers.
3 soldering aids. Reel of De-Solder
braids.



ADAMIN Miniature Iron £7.90

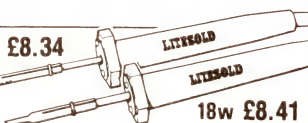
Possibly smallest mains iron in the
world. Ideal for fine work. Slim

nylon handle with finger grip.
Interchangeable bits available
Fitted with 2.4mm. 240v 12w



'L' Series Lightweight Irons. 12w £8.34

High efficiency irons for all
electronic hobby work. Non-roll
handles with finger guards.
Stainless steel element shafts. Screw-
connected elements. Slip-on bits
available from 1.6 to 4.7mm. LA12



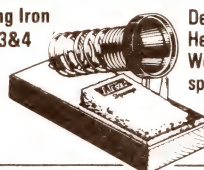
18w £8.41

model, 12w, 2.4mm bit. LC 18 Model,
18w, 3.2mm bit. 240v Std

Soldering Iron

Stands 3&4

£6.85



Designed specially for LITESOLD irons.
Heavy, solid-plastic base with non-slip pads.
Won't tip over, holds iron safely. With wiping
sponge and location for spare (hot) bits.
No 4 stand for ADAMIN miniature Iron
No 3 stand for LA12 and LC18 Irons.

De-Solder Pumps £8.03

High Quality version of increasingly
popular type of tool. Precision made
anodised aluminium body, plunger
guard and high-seal piston. Easy



thumb operation. Automatic solder
ejection. Conductive PTFE nozzle -
no static problems.

Prices include p&p and VAT. Send order
with Cheque/P.O. Ring for Access/Visa sales



LIGHT SOLDERING DEVELOPMENTS LTD.
97-99 GLOUCESTER ROAD, CROYDON CR0 2DN. 081 689 0574

EVERYDAY ELECTRONICS

CLASSIFIED

EE reaches 40% more UK readers than any other independent monthly hobby electronics magazine, our audited ABC sales figures prove it. EE has been the leading independent monthly magazine in this market for the last six years

If you want your advertisements to be seen by the largest readership at the most economical price our classified and semi-display pages offer the best value. The prepaid rate for semi-display space is £8 (+ VAT) per single column centimetre (minimum 2.5cm). The prepaid rate for classified adverts is 30p (+ VAT) per word (minimum 12 words).

All cheques, postal orders, etc., to be made payable to Everyday Electronics. **VAT must be added.** Advertisements, together with remittance, should be sent to the Classified Advertisement Dept., Everyday Electronics, 6 Church Street, Wimborne, Dorset BH21 1JH. Tel: (0202) 881749.
For rates and information on display advertisements ('eth page and larger spaces) please contact our Advertisement Manager, Peter Mew on 0255 850596.

THE BRITISH AMATEUR ELECTRONICS CLUB
exists to help electronics enthusiasts by personal contact and through a quarterly Newsletter. For details, write to the Chairman:

**Mr H. F. Howard, 41 Thingwall Park
Fishponds, Bristol BS16 2AJ**

SERVICE MANUALS

Available for most equipment. TV, Video, Audio, Test, Amateur Radio, Military Surplus, Kitchen, etc. Any Video Recorder, Video Camera or Oscilloscope Manual £15.00 (subject to stock).

All other Manuals £10.00 (subject to stock).

State Make and Model required with order. Over 100,000 manuals available for equipment from 1930's to the present. Circuit sections supplied on full size sheets up to A1 size (33" x 24") if applicable. Originals or photostats supplied as available.

FREE Repair and Data Guide Catalogue with all orders or send SAE for your copy today

MAURITRON (EE)

8 Cherry Tree Road, Chinnor,
Oxfordshire OX9 4QY
Tel: (0844) 51694
Fax: (0844) 52554

BTEC ELECTRONICS TECHNICIAN FULL-TIME TRAINING

THOSE ELIGIBLE CAN APPLY FOR E.T. GRANT SUPPORT
AN EQUAL OPPORTUNITIES PROGRAMME

O.N.C., O.N.D. and H.N.C.

Next course commences
Monday 27th April 1992
FULL PROSPECTUS FROM

LONDON ELECTRONICS COLLEGE
(Dept EE) 20 PENYWERN ROAD
EARLS COURT, LONDON SW5 9SU
TEL: 071-373 8721

IT PAYS TO ADVERTISE WITH EVERYDAY ELECTRONICS

Your advert will reach 40% more readers than with any other independent monthly hobby electronics magazine

Rechargeable Batteries

	Quantity	1-99	100-499
AA (HP7) 500mAh		£0.99	£0.77 + VAT
AA 500mAh solder tags		£1.55	£0.95 + VAT
AA 700mAh high capacity		£1.95	£1.20 + VAT
C (HP11), 1.2AH		£2.20	£1.69 + VAT
C 2AH with solder tags		£3.60	£2.25 + VAT
D (HP2) 1.2AH		£2.60	£1.96 + VAT
D 4AH with solder tags		£4.95	£3.59 + VAT
PP3 8.4V 110mAh		£4.95	£3.85 + VAT
Sub C with solder tags 1.2AH		£2.50	£1.70 + VAT
1/2 AA with solder tags		£1.55	£1.17 + VAT
AAA (HP16) 180mAh		£1.75	£1.15 + VAT

Special offers for unusual sizes only while stocks last. Please check availability before ordering.

	Quantity	1-99	100-499
F cell 7AH 32 x 87mm with flat top		£3.95	£2.80 + VAT
F cell with solder tags		£4.30	£3.00 + VAT
Cellular telephone battery			
42mm long x 16mm dia		£1.45	£0.95 + VAT
Stick of 4 171 x 16 dia with 150mm red & black leads		£5.95	£4.00 + VAT
4 cell battery 94 x 25mm 4.8V		£3.50	£2.30 + VAT

All 1 to 99 prices include VAT

Please add 95p postage & packing per order

JPG Electronics

276-278 Chatsworth Road, Chesterfield S40 2BH
Access & Visa orders tel: (0246) 211202

RCS VARIABLE VOLTAGE D.C. BENCH POWER SUPPLY

1 to 24 volts up to 1/2 amp. 1 to 20 volts up to 1 amp. 1 to 16 volts up to 1 1/2 amps d.c. Fully stabilised. Twin panel meters for instant voltage and current readings. Overload protection

Fully variable. Operates from 240V a.c. Size 9 x 5 1/2 x 3 in. **£45 inc. VAT** + Post and

NEW MODEL. Up to 38volts d.c. at 6 amps. 10 amps peak. Fully variable. Twin panel meters. Size 14 1/2 x 11 x 4 1/2 in. **£98 inc. VAT.** Carr £6

RADIO COMPONENT SPECIALISTS

337 WHITEHORSE ROAD, CROYDON
SURREY, U.K. Tel: 081-6841665

List. Large SAE. Delivery 7 days. Callers welcome. Closed Wednesday

PLEASE MENTION EVERYDAY ELECTRONICS WHEN REPLYING TO ADVERTISEMENTS

NEW VHF MICROTRANSMITTER KIT

Tunable 80-135MHz, 500 metre range, sensitive electret microphone, high quality PCB.

SPECIAL OFFER complete kit ONLY £5.95

Assembled and ready to use £9.95 post free.

Access/Visa orders telephone 021 411 1821

Send 2x1st class stamps for Catalogue. Cheques/P.O.s payable to:

QUANTEK ELECTRONICS LTD

Kits Dept. (EE), 3 Houldrey Road, West Heath,

Birmingham B31 3HL

SHOP NOW OPEN - CALLERS WELCOME

Typefit

The Typesetting programme for all your Typesetting needs.
If you need typesetting for your Adverts, Brochures, etc. Typefit can help you.

Please telephone

0202 882299

N. R. BARDWELL LTD (EE)

200	Signal diodes 1N4148.....	£1.00
75	Rectifier Diodes 1N4001.....	£1.00
75	Rectifier Diodes 1N4003.....	£1.00
50	Rectifier Diodes 1N4007.....	£1.00
56	Rectifier Diodes 1N5401.....	£1.00
10	NE555 Timer i.c.s.....	£1.00
5	741 Op Amp i.c.s.....	£1.00
8	C106D1 400V 6 amp thyristors.....	£1.00
8	BFY51 Transistors.....	£1.00
30	BC478 Transistors.....	£1.00
30	MPSA92 Transistors.....	£1.00
25	Asstd. high brightness i.e.d.s.....	£1.00
50	Axial i.e.d.s (Diode package) wide angle red.....	£1.00
50	Rectangular red i.e.d.s.....	£1.00
20	Miniature axial i.e.d.s super bright red.....	£1.00
24	Miniature red i.e.d.s 3mm dia.....	£1.00
12	Asstd. seven segment displays.....	£1.00
4	43" Com. anode seven segment displays.....	£1.00
100	22NF 100V radial film capacitors.....	£1.00
100	33NF 50V radial film capacitors.....	£1.00
200	Asstd. disc ceramic capacitors.....	£1.00
80	4U7 16V Radial electrolytics.....	£1.00
75	4U7 63V Radial electrolytics.....	£1.00
80	10UF 16V Radial electrolytics.....	£1.00
50	10UF 50V Radial electrolytics.....	£1.00
80	22UF 25V Radial electrolytics.....	£1.00
60	33UF 16V Radial electrolytics.....	£1.00
80	47UF 16V Radial electrolytics.....	£1.00
50	47UF 50V Radial electrolytics.....	£1.00
80	100UF 10V Radial electrolytics.....	£1.00
50	220UF 16V Radial electrolytics.....	£1.00
60	470UF 10V Radial electrolytics.....	£1.00
40	1000UF 10V Radial electrolytics.....	£1.00
30	Asstd. IF transformers.....	£1.00
48	Asstd. coil formers.....	£1.00
100	Asstd. RF chokes.....	£1.00
30	Asstd. di sockets up to 40 pin.....	£1.00
30	Assorted socket/conn's/edge-dil-sil-etc.....	£1.00
20	1 inch Glass reed switches.....	£1.00
10	4P 3W MBB min. rotary switches.....	£1.00
20	Min SP/CO slide switches.....	£1.00
20	Magnetic ear pips plus lead & plug.....	£1.00
1	Peltier effect heat pump.....	£1.95
1	10 watt Stereo amplifier, 4 controls plus data.....	£2.95
1	10mm Flashing i.e.d. red.....	£0.75
1	10mm Ultra bright i.e.d. red 300 MCD.....	£0.60

Prices include VAT, postage £1.00. Stamp for Lists

288 Abbeydale Road, Sheffield S7 1FL
Phone (0742) 552886. Fax (0742) 500689

Miscellaneous

KITS, PLANS, ETC for surveillance, protection (sonic, HV), "007" gear. Send 2 x 22p stamps for list. ACE(EE), 53 Woodland Way, Burntwood, Staffs.

G.C.S.E. ELECTRONICS KITS at pocket money prices. S.A.E. for FREE catalogue. SIR-KIT ELECTRONICS, 70 Oxford Road, Clacton CO15 3TE.

PROTOTYPE PRINTED CIRCUIT BOARDS one offs and quantities, for details send s.a.e. to B.M.A. Circuits, 38 Poynings Drive, Sussex BN3 8GR, or phone Brighton 720203.

BUMPER COMPONENT PACKS only £1.50 inc p&p. 16 Rollestons, Writtle, Essex (0860) 821440. Callers welcome by appointment.

EPROM programming, copying and updating from any device or software format. 10 day turnaround. Call/Fax: FTL 0491 681502/681944.

COMPONENTS

For TV ★ Video
Audio ★ Computer

VIDEO BELT KITS	
AMSTRAD VCR4600/4700/5200.....	£3.19
FISHER FVHP905/906/908.....	£3.03
JVC HR3300/3330/3660.....	£2.79
SANYO VTC5000/5150/5500.....	£1.49
SANYO VTC6500.....	£2.23
THORN 8900 to 8922.....	£2.79
VIDEO PINCH ROLLERS	
AMSTRAD VCR4600/4600/4700.....	£7.07
HITACHI VT11/V1733.....	£5.17
JVC Above models.....	£5.17
SHARP VC381/386/388/390.....	£5.67
THORN 3V00/06/16/22/23/24.....	£5.17
SERVICE MANUALS	
BINATONE 01/9771.....	£6.99
PHILIPS 22DC570/670-00.....	£3.25
PHILIPS KT4/K40 Chassis.....	£10.00
OTHER SPARES	
FERGUSON 3V23/29/30/32.....	£3.55
Reel Idler.....	£3.55
HITACHI VT11/14/33/34/61/62/63.....	£26.10
Video Head.....	£26.10
SHARP RGF281/4 Main belt.....	£1.40
TOSHIBA STU2 Mains transformer.....	£9.99

LEADS & CONNECTORS	
'Universal' Video Lead Kit.....	£7.40
9 piece 'Scart' Video Lead Kit.....	£8.59
AC Mains lead - 2pin fig. 8.....	£0.61
INTEGRATED CIRCUITS	
LM733CN.....	£2.27
TBA530.....	£1.14
TBA810P.....	£1.40
TDA1001B.....	£2.66
AERIALS & EQUIPMENT	
FM Omnidirectional Aerial.....	£18.24
UHF TV Aerial.....	£8.89
(10 element - Band A).....	£1.99
Loft Mast/Bracket.....	£1.99
75Ω CO-ax Cable.....	per m/£0.23
Cable clips.....	per 10/£0.21

TELEPHONE ACCESSORIES	
B.T. Plug-in Tone Ringer.....	£6.95
Socket Doubler.....	£3.68
IDC Junction Box.....	£3.95
5m Extension Lead.....	£4.20
LJU2 Secondary Slt. & Box.....	£2.30
LJU3 Secondary Slt. (Flush).....	£2.67
4 core cable.....	per m/£0.15
Cable clips.....	per 10/£0.20
TOOLS & BATTERY ACCS.	
UNIROSS Plug-in 'Fast' Charger.....	£5.49
for AAA/AA Ni-CAD's.....	£2.09
UNIROSS 'C' Ni-Cad. Battery.....	£8.25
WELLER WM120 Micropoint.....	£8.25
Soldering Iron 12W/240Vac.....	£2.45
'Universal' Crimping Tool.....	£0.80
Junior Hacksaw.....	£0.58
Craft Knife & Spare Blade.....	£0.58

This is just a small sample of stock. Our latest Price List is free on request with first order - Alternatively please send 50p Stamps/Cheq./3xIRC's towards P&P for a copy by return.

WE CAN SUPPLY A VAST RANGE OF SPARES for many makes of TV, Video, Computer & Audio Equipment. **WRITE** (Encl. s.a.e. please) or **PHONE** **0452 526883** FOR A 'PRICE & AVAILABILITY' on your requirements.

COMPUTER SPARES	
AMSTRAD/SINCLAIR	
IC 40007 G. Array.....	£19.86
IC 40010 G. Array.....	£18.86
IC AY380/12A.....	£7.32
IC HA13100.....	£7.67
IC HD6845SP.....	£15.18
IC LA414C.....	£1.70
IC PEGA1A.....	£30.95
IC UPC1378H.....	£2.45
IC Protector N75.....	£1.55
Cement Resistor 5.6Ω/5W.....	£1.18
(Monitors).....	£4.99
Transistor 2SD1397.....	£2.07
Jack Slt. (CPC I/O).....	£6.71
Joystick (CPC range).....	£8.49
Service Manual.....	£13.89
CPC 464 (early).....	£10.95
Service Manual.....	£14.25
PCV8256/8512.....	£11.40
User Manual CPC464.....	£4.49
Service Manual.....	£1.18
ATARI	
IC CO14806 (XE/L).....	£4.49
IC CO29947 (XE/L).....	£1.34
THERMISTOR (ST-PSU).....	£1.20
TL431 (ST-PSU).....	£4.42
CNY65 (ST-PSU).....	£4.73
PC101 (ST-PSU).....	£2.94
PC713V (STE-PSU).....	£11.40
We can supply most ST-PSU Transistors.....	£2.99
PHILIPS	
Serv. Manual BM7502.....	£2.99
Serv. Manual BM7513.....	£3.80
Serv. Manual CM8833.....	£10.95
Serv. Info. CM85, 87, 88, 82.....	£1.49

All above are manufacturers original spares. We can also supply manuals and parts for Olivetti & Panasonic.

OTHER COMPUTER CHIPS	
6502 CPU.....	£5.05
6522 VIA.....	£4.49
6818 RT Clock.....	£7.24
8255A PPI.....	£2.82
8272A FDC.....	£14.09
AM26LS31PC.....	£1.63
75154PC 4xline driver.....	£1.85
64Kx1 DRAM (120ns).....	£1.99
64Kx1 DRAM (150ns).....	£1.69
64Kx4 DRAM (100ns).....	£2.99

MARCH SPECIAL OFFERS	
10% OFF	
Tools & Battery Accessories -	18p ea. (1+)
As shown in this advertisement and our	15p ea. (5+)
current catalogue.....	TEXAS DRAM (TMS4532-15N1.4) - For Spectrum 48K
SED 9420CAC.....	£1.72 ea. (1+)
AMIGA A500 (early) Genuine Service Manual.....	£1.22 ea. (5+)
	£19.95

MAIL ORDER ONLY. Please add 95p (UK) P&P but not VAT. All items subject to availability - Prices can change without notice.

MARAPET (EEC)
1 HORNBEAM MEWS
GLOUCESTER GL2 0UE



NATIONAL
COLLEGE OF
TECHNOLOGY

DISTANCE LEARNING COURSES

The National College of Technology offer a range of packaged learning short courses for study at home or in an industrial training environment which carry national BTEC awards. Study can commence at any time and at any level enabling you to create a study routine to fit around existing commitments. Courses on offer include:

Analogue Electronics
Digital Electronics
Fibre/Optoelectronics
Programmable Logic Controllers

Tutor support and BTEC certification are available as options with no travelling or college attendance required. These very popular courses which are ideal for vocational training contain workbooks, audio cassette lecturettes, PCB's, instruments, tools, components and leads as necessary to support the theoretical and practical training. Whether you are a newcomer to electronics or have some experience and simply need an update or certification, there is probably a distance learning course ready for you. Write or telephone for details to:

National College of Technology
NCT Ltd., PO Box 11
Wendover, Bucks
Tel: (0296) 624270

Technical Information Services

76 CHURCH STREET, LARKHALL, LANARKSHIRE, ML9 1HE

Tel. (0698) 884585 Mon-Fri 8.30am - 5.00pm

Tel. (0698) 883334 Outwith business hours

FAX facility available all day on both lines

Write now with an SAE for your

FREE QUOTE FREE VOUCHERS & FREE CATALOGUE

Remember, not only do we have EVERY service sheet ever produced, but we also have

THE WORLDS LARGEST COLLECTION OF SERVICE MANUALS

& WE ARE SOLE SUPPLIERS OF VARIOUS FAULT-FINDING GUIDES REPAIR MANUALS & TECHNICAL MANUALS

CTV, Video, CD, Hi-Fi, Camcorder, Satellites, Computers, Domestic Equip', etc

DATA REFERENCE MANUAL ".....essential for the serious electrician"
FREE updating and a 10% discount voucher only £5.95
Incorporates Unique Model Identification and Chassis Data

CAMBRIDGE COMPUTER SCIENCE LIMITED

3.5" 720K Diskette Drives.....	£29.00 each
10MByte Winchester, used, 3 months Wty.....	£35.00 each
5.25" Disk Drives, 80 Tk. DSD.....	£25.00 each
5.25" Disk Drives, 80 Tk. DSD, Used, No Wty (£15.00 drives sold on strictly "as is" basis).....	£15.00 each
5.25" Disks, DSD, 48tpi, boxes of 10 (free disk cleaner with 5 boxes).....	£3.00/box
Lockable diskette boxes for 80" 3.5" or 100" 5.25" (state which).....	£5.99 each
Small sized diskette boxes (lockable).....	40" 3.5" £4.75, 50" 5.25" £4.99
Printer stands (suit 80/132 coils).....	Basic £2.99, or with paper catcher £10.99
Digital multimeter, 14 ranges, inc leads & manual.....	£16.00 each
Apricot Disk drive PSU.....	£10.00 each
5V at 6A PSU.....	£4.80 each
5V at 10A PSU.....	£6.40 each
Ni-Cads AA £0.89, C £1.99, D £2.09, PP3 £4.99.....	Universal charger £5.99 each
Disk Drive Data lead BBC Micro to Disk Drives.....	Single £2.00 Dual £4.00 each
Disk Drive Power lead BBC Micro to Disk Drives.....	Single £2.00 Dual £4.00 each
74LS TTL, pick and mix, buy 10 or more for 1 types available: 00 02 04 08 10 11 12 13 14 15 20 21 26 27 30 32 33 37 38 42 74 85 85 86 96 107 109 122 125 132 136 138 139 145 151 153 157 158 160 162 163 164 165 174 191 193 240 253 257 260 298 353 365 366 373 385 390 399 670 682.....	£0.12 each
27128 EPROMS (ex equipment).....	£1.20 each or £5.00/5
256K Byte DRAM Modules, removed from equipment.....	£6.00 each
6264-12 8K Byte SRAM.....	£3.80 each
62256-10 32KByte SRAM.....	£5.00 each
65256 32K Byte RAMs.....	£4.00 each
8K Byte NV ram chips £3.00 each.....	£10.00 four

Prices include postage. Add 50p (plus VAT) to orders below £5.00. All items new unless stated.

Add 17.5% VAT to all prices. Send an SAE for our latest list or for more info.

Dept EE, 374 Milton Road, Cambridge CB4 1SU
Tel: 0223 424602, 0831 430496 or 0831 430552 (Please note mail order only)

OMNI ELECTRONICS

174 Dalkeith Road, Edinburgh EH16 5DX 031 667 2611

A COMPREHENSIVE RANGE WITH SERVICE SECOND TO NONE

OUR MUCH EXPANDED, BETTER ILLUSTRATED CATALOGUE COSTS £1.50 - INCLUDES VOUCHERS TO USE AGAINST FUTURE PURCHASES. TO RECEIVE A COPY PLEASE SEND YOUR REMITTANCE WITH THE VOUCHER BELOW.

Please send me a copy of the 1990/91 OMNI catalogue.
Payment of £1.50 enclosed

NAME.....
ADDRESS.....
TELEPHONE.....



Open: Mon.-Thurs. 9.15 - 6.00
Friday 9.15 - 5.00
Saturday 9.30 - 5.00



LIGHTING CONTROLLER KITS

For the serious Mobile Disco
SWITCHABLE 3-4 CHANNEL CONTROLLER
with Beat Chase and Speed Controls
PCB + Components Kit£21.00
Hardware Kit£12.00



MULTI-CHASE 4 CHANNEL CONTROLLER
with Beat Chase, Speed and Chase-
Select Controls
PCB + Components Kit£26.00
Hardware Kit£13.00

COMPUTER CHASE 4 CHANNEL CONTROLLER

A Controller designed to achieve very good results from many types of lighting display. Perfect for pinspots, super on screens, can even revitalize spotlight boxes. Fast tracking autolevel audio input and choice of sound modes ensure accurate and varied interpretation of music.

PCB + Components Kit£35.00
Hardware Kit£15.00

Postage & Packing £1.50 per order

LOUDSPEAKER KITS

High Powered Speakers for P.A. and Disco Use
ready made black Vynide covered
cabinets, cutout ready for fitting of
wide dispersion horn and 12" 100 watt
RMS Driver or 15" 200watt RMS Driver.
Kit contains all fixings, clamps, sockets,
labels etc.

MAGNUM 100 (1 x 12" + 7" x 3" Horn) £165 pair
Size 540mm x 380mm x 300mm

MAGNUM 200 (1 x 15" + 7" x 3" Horn) £235 pair
Size 635mm x 460mm x 330mm



Carrier Delivery £12.00 pair

TEST EQUIPMENT KITS

LED DISPLAY OSCILLOSCOPE with
9x9 grid of high efficiency LEDs with
trigger/freerun, brightness, sensitivity,
position and timebase.

£19.95

WAVEFORM GENERATOR with
sine, triangle and square wave
output. Range, frequency and
amplitude.

£9.95

Postage & Packing 50p

FAST FRIENDLY SERVICE

ALL PRICES INCLUDE VAT

NORTECH electronic

98 School Street, Wolverhampton, West Midlands WV3 0NR.
Tel: (0902) 23275

TEST EQUIPMENT MAINTENANCE AND TECHNICAL CONSULTANCY

- ☐ Service manuals
- ☐ Spare parts
- ☐ Comprehensive repair service including complete instrument refurbishment at highly competitive rates for radio amateurs

Distributors for:
WAUGH INSTRUMENTS
RAMTEST LTD
KRENZ-ELECTRONICS

- ☐ We support scientific, commercial and industrial equipment manufactured by over 100 different companies
- ☐ New and second-hand test equipment also available at competitive prices
- ☐ Components, valves and miscellaneous items

Hesing Technology HT

41 Bushmead Road, Eaton Socon, St. Neots, Cambs PE19 3BT
Telephone and Fax: (0480) 214488

MAKE YOUR INTERESTS PAY!

Over the past 100 years more than 9 million students throughout the world have found it worth their while! An ICS home-study course can help you get a better job, make more money and have more fun out of life! ICS has over 90 years experience in home-study courses and is the largest correspondence school in the world. You learn at your own pace, when and where you want under the guidance of expert personal tutors. Find out how we can help YOU. Post or phone today for your **FREE INFORMATION PACK** on the course of your choice. (Tick one box only)

Electronics	☐ TV, Video & Hi-Fi Servicing	☐
Basic Electronic Engineering (City & Guilds)	☐ Refrigeration & Air Conditioning	☐
Electrical Engineering	☐ Car Mechanics	☐
Electrical Contracting/Installation	☐ Computer Programming	☐
GCSE/GCE/SCE over 40 examination subjects to choose from		

Name _____ Address _____
ICS International Correspondence Schools Dept EC3 32 312/314 High Street, Sutton, Surrey SM1 1PR.
Telephone 081-643 9568 or 041-221 2926 (24 hours)

ADVERTISERS INDEX

ANTEX (ELECTRONICS).....	132	ICS.....	192
N. R. BARDWELL.....	190	JAYTEE ELECTRONIC SERVICES.....	187/189
BK ELECTRONICS.....	Cover (iii)	JPG ELECTRONICS.....	190
BRIAN J. REED.....	192	LITESOLD.....	189
BULL ELECTRICAL.....	Cover (ii)	M&B ELECT. SUPPLIES.....	159
CAMBRIDGE COMP. SCIENCE.....	191	MAGENTA ELECTRONICS.....	134/135
CIRKIT DISTRIBUTION.....	141	MAPLIN ELECTRONICS.....	Cover (iv)
COMPELEC.....	192	MARAPET.....	191
CRICKLEWOOD ELECTRONICS.....	169	MAURITRON TECH. SERV'S.....	190
CR SUPPLY COMPANY.....	189	NATIONAL COLLEGE OF TECH.....	191
EAGLE PUBLICATIONS.....	169	NORTECH ELECTRONIC.....	192
ELECTRONIZE DESIGN.....	132	NUMBER ONE SYSTEMS.....	141
ESR ELECTRONIC COMP.....	133	OMNI ELECTRONICS.....	191
ELECTROVALUE.....	132	PICO TECHNOLOGY.....	169
FJP KITS & COMPONENTS.....	187	SHERWOOD ELECTRONICS.....	169
GREENWELD ELECTRONICS.....	136	SUMA DESIGNS.....	183
HAPPY MEMORIES.....	169	TANDY.....	145
HART ELECTRONIC KITS.....	173	TECHNICAL INFO. SERVICES.....	191
HESING TECHNOLOGY.....	192	TK ELECTRONICS.....	132
HIGH-Q ELECTRONICS.....	189	TYPESETTING BUREAU.....	187
HOBBYKIT.....	130		

Millions of quality components at lowest ever prices!

Plus Tools, Watches, Fancy Goods, Toys.
Mail order UK only.

All inclusive prices –

NO post, or VAT etc to add on.

Send 34p stamped self addressed label or envelope for catalogue/clearance list.

At least 2,100 offers to amaze you.

Brian J Reed

**6 Queensmead Avenue, East Ewell
Epsom, Surrey KT17 3EQ
Tel: 081-393 9055**

Metal detector boards with Data has tuner, mode, discriminate, headphone jack, on/off volume & push button facilities.£7.95 ea*

Dictaphone cassette, mech/record erase playback heads, 6V solenoid, motor, hall effect switch.£2.00 ea*

T.V./Printer stands£3.95 ea*

Bicc-Vero Easiwire construction kit.£4.95 ea*

TTL/CMOS short circuit snooper.....£4.95*

Dot matrix LCD 10x2 lines£3.75 ea*

Dot matrix LCD 16 x 1 lines with Data£4.95*

20 characters x 2 lines dot matrix LCD with data£7.95*

40 characters x 1 line dot matrix LCD with data£15.00*

2 digit 16 segment VF display with data£2.95 ea*

4 digit intelligent dot matrix display.....£6.00*

17 segment V.F. display with driver board and data£2.99 ea*

8 digit liquid crystal display.....£1.75 ea*

4 digit LCD with 7211 driver chip.....£3.50 ea*

Digital clock display.....£2.50*

11 key membrane keypad.....£1.50 ea*

Keyboard 392mm x 180mm/100 keys on board + LCD + 74HC05/80C49 easily removable.....£4.95

19" 3U sub rack enclosures.....£8.95

12V stepper motor, 48 steps per rev, 7.3° step angle.....£3.95 ea*

Stepper motor board with 2 slotted opto + 2 mercury tilt switches.....£3.95 ea*

1000 mixed 1/4 watt 1% resistors.....£4.95 ea*

250 electrolytic axial + radial caps.....£4.95 ea*

200 off mixed polyester caps.....£7.95*

100 Mixed trimmer caps popular values.....£4.95*

50 off MC 78M12CT Volt Regs.....£2.95*

20 off W02M Volt Regs.....£1.50*

25 off asst. buzzers & sounders.....£4.95*

Cable box UHF modulator/video preamp/transformer/R's + C's/leads.....£6.95

1000 off mixed Multilayer Ceramic Caps.....£7.95

Solar cell modules 0.45V 700mA.....£2.95 ea*

B.B.C. Micro to disc drive lead.....£1.50*

Car Burglar alarm vibration auto entry/exit delay.....£5.95 ea*

Single zone alarm panel auto entry/exit delay housed in domestic light socket.....£9.95 ea*

P.C. P.S.U. 50 watt 115-230V input + 5V 4A + 12V 2.5A output with built in fan, IEC inlet + on off.....£9.95 ea

STC P.S.U. 240V input 5V 6A output (converts to 12V 3A details available).....£5.95 ea

240V input 5V 10A output (converts to 12V 5A no details).....£5.95 ea

6000 line output transformers.....£1.25 ea

240V in 0-12V 0.75A out transformer.....£1.75*

240V in 0-28V 62VA out transformer.....£2.75

Transformer + PCB gives 2x7.5V 32VA with skt for 5 or 12V regulator, will power floppy drive.....£3.75 ea

Ultrasonic transducers (transmit + receive).....£1.50 pair

3 to 16V Piezoelectric sounders.....50p*

9VDC electromechanical sounder.....50p*

24V DC electromechanical sounder.....50p*

2A 250V keyswitch 3 position key removable in two positions.....£1.50*

DIL switches PCB MT 3/4/6 way.....35p*

5V SPICO SIL reed relay.....40p*

5V 2PCO DIL miniature relay.....60p*

12V 2PCO or 4PCO continental relay.....60p*

12V 10A PCB MT (to make contact) relay.....95p*

3 to 12V electro magnetic acoustic transducer with data.....75p*

2.4576/8.8329/21.10 MHz crystals.....50p ea*

Bridges 25A 200V.....£1.00*

2A 100V.....50p*

31b Mixed components pack.....£4.95

25 off mixed relays.....£5.95*

40 off mixed toggle switches.....£9.95*

50 off mixed switches, toggle, rocker, slide, micro.....£9.95

Miniature axial chokes 0.1, 0.18, 0.12, 0.33, 0.39, 0.15, 1, 3.3UH.....10p ea., 100 for £7.50*

50 Mixed terminal blocks.....£2.95

250off 16/22/24/40 way IC Skts.....£4.95

100 off Phono plugs (red/black/grey).....£3.50*

QUANTITY DISCOUNTS AVAILABLE PLEASE RING

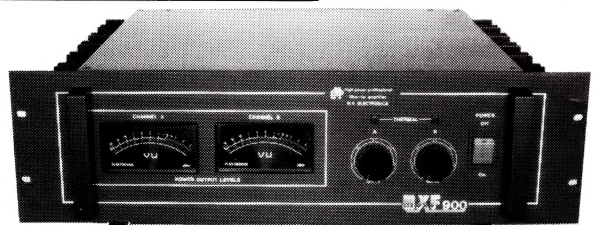
ALL PRICES INCLUDE V.A.T. PLEASE ADD £2.00 p&p EXCEPT ITEMS MARKED* WHICH ARE 50P. SAE FOR BULK BUYING LIST PAYMENT WITH ORDER TO:
Dept EE, COMPELEC, 14 Constable Road, St. Ives, Huntingdon, Cambs PE17 6EQ, Tel/Fax: 0480 300819

OMP POWER AMPLIFIER MODULES-TURNABLES-DIMMERS-LOUDSPEAKERS-19 INCH STEREO RACK AMPLIFIERS

* PRICES INCLUDE V.A.T. * PROMPT DELIVERIES * FRIENDLY SERVICE * LARGE (A4) S.A.E., 50p STAMPED FOR CATALOGUE *

OMP MOS-FET POWER AMPLIFIERS
HIGH POWER, TWO CHANNEL 19 INCH RACK

THOUSANDS PURCHASED BY PROFESSIONAL USERS



THE RENOWNED MXF SERIES OF POWER AMPLIFIERS
FOUR MODELS:- MXF200 (100W + 100W) MXF400 (200W + 200W)
MXF600 (300W + 300W) MXF900 (450W + 450W)

ALL POWER RATINGS R.M.S. INTO 4 OHMS, BOTH CHANNELS DRIVEN
FEATURES: ★ Independent power supplies with two toroidal transformers ★ Twin L.E.D. Vu meters ★ Level controls ★ Illuminated on/off switch ★ XLR connectors ★ Standard 775mV inputs ★ Open and short circuit proof ★ Latest Mos-Fets for stress free power delivery into virtually any load ★ High slew rate ★ Very low distortion ★ Aluminium cases ★ MXF600 & MXF900 fan cooled with D.C. loudspeaker and thermal protection.

USED THE WORLD OVER IN CLUBS, PUBS, CINEMAS, DISCOS ETC.

- SIZES:-** MXF200 W19"xH3 1/2" (2U)xD11"
MXF400 W19"xH5 1/4" (3U)xD12"
MXF600 W19"xH5 1/4" (3U)xD13"
MXF900 W19"xH5 1/4" (3U)xD14 1/2"

PRICES:- MXF200 £175.00 MXF400 £233.85
MXF600 £329.00 MXF900 £449.15
SPECIALIST CARRIER DEL. £12.50 EACH



OMP VARISPEED TURNTABLE CHASSIS



★ Manual arm ★ Steel chassis ★ Electronic speed control 33 & 45 R.P.M. ★ Vari pitch control ★ High torque servo driven DC motor ★ Transit screws ★ 12" die cast platter ★ Neon strobe ★ Calibrated balance weight ★ Removable head shell ★ 1/2" cartridge fixings ★ Cue lever ★ 220/240V 50/60Hz ★ 390x305mm ★ Supplied with mounting cut-out template.

PRICE £61.30 + £3.70 P&P

OPTIONAL MAGNETIC CARTRIDGES

STANTON AL500mkII **GOLDRING G950**
PRICE £16.95 + 50p P&P **PRICE £7.15 + 50p P&P**

STEREO DISCO MIXER DJ6500

★ WITH ECHO ★

STEREO DISCO MIXER with 2 x 7 band L & R graphic equalisers with bar graph LED Vu meters. **MANY OUTSTANDING FEATURES:-** including Echo with repeat & speed control, DJ Mic with tone control & talk-over switch, 7 Channels with individual faders plus cross fade, Cue Headphone Monitor. Useful combination of the following inputs:- 3 turntables (mag), 3 mics, 5 Line for CD, Tape, Video etc.

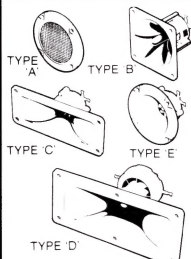
Price £134.99 + £5.00 P&P



SIZE: 482 x 240 x 120mm

PIEZO ELECTRIC TWEETERS - MOTOROLA

Join the Piezo revolution! The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover is not required these units can be added to existing speaker systems of up to 100 watts (more if two are put in series). **FREE EXPLANATORY LEAFLETS ARE SUPPLIED WITH EACH TWEETER.**



TYPE 'A' (KSN1036A) 3" round with protective wire mesh. Ideal for bookshelf and medium sized Hi-Fi speakers. **Price £4.90 + 50p P&P.**
TYPE 'B' (KSN1005A) 3 1/2" super horn for general purpose speakers, disco and P.A. systems etc. **Price £5.99 + 50p P&P.**
TYPE 'C' (KSN1016A) 2" x 5" wide dispersion horn for quality Hi-Fi systems and quality discos etc. **Price £6.99 + 50p P&P.**
TYPE 'D' (KSN1025A) 2" x 6" wide dispersion horn. Upper frequency response retained extending down to mid-range (2KHz). Suitable for high quality Hi-Fi systems and quality discos. **Price £9.99 + 50p P&P.**
TYPE 'E' (KSN1038A) 3 3/4" horn tweeter with attractive silver finish trim. Suitable for Hi-Fi monitor systems etc. **Price £5.99 + 50p P&P.**
LEVEL CONTROL Combines, on a recessed mounting plate, level control and cabinet input jack socket. 85x85mm. **Price £4.10 + 50p P&P.**

OMP LINNET LOUDSPEAKERS

THE VERY BEST IN QUALITY AND VALUE

Made especially to suit today's need for compactness with high output sound levels, finished in hard wearing black vinylite with protective corners, grille and carrying handle. Each unit incorporates a 12" driver plus high frequency horn for a full frequency range of 45Hz-20KHz. Both models are 8 Ohm impedance. Size: H20" x W15" x D12".

CHOICE OF TWO MODELS

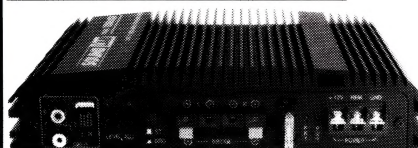
POWER RATINGS QUOTED IN WATTS RMS FOR EACH CABINET

OMP 12-100WATTS (100dB) PRICE £163.50 PER PAIR
OMP 12-200WATTS (200dB) PRICE £214.55 PER PAIR

SPECIALIST CARRIER DEL. £12.50 PER PAIR



IN-CAR STEREO BOOSTER AMPS



PRICES: 150W £49.99 250W £99.99
400W £109.95 P&P £2.00 EACH

THREE SUPERB HIGH POWER CAR STEREO BOOSTER AMPLIFIERS

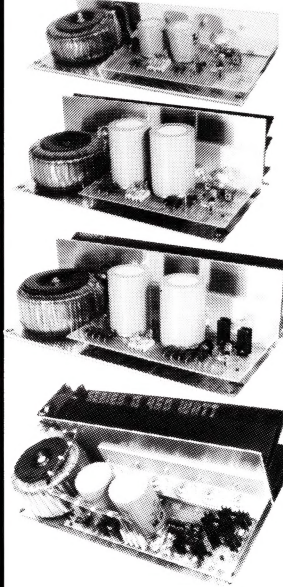
150 WATTS (75 + 75) Stereo, 150W Bridged Mono
250 WATTS (125 + 125) Stereo, 250W Bridged Mono
400 WATTS (200 + 200) Stereo, 400W Bridged Mono
ALL POWERS INTO 4 OHMS
Features:
★ Stereo, bridgable mono ★ Choice of high & low level inputs ★ L & R level controls ★ Remote on-off ★ Speaker & thermal protection.

OMP MOS-FET POWER AMPLIFIER MODULES

SUPPLIED READY BUILT AND TESTED.

These modules now enjoy a world-wide reputation for quality, reliability and performance at a realistic price. Four models are available to suit the needs of the professional and hobby market i.e. Industry, Leisure, Instrumental and Hi-Fi etc. When comparing prices, NOTE that all models include toroidal power supply, integral heat sink, glass fibre P.C.B. and drive circuits to power a compatible Vu meter. All models are open and short circuit proof.

THOUSANDS OF MODULES PURCHASED BY PROFESSIONAL USERS



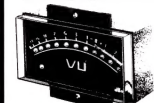
OMP/MF 100 Mos-Fet Output power 110 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 45V/uS, T.H.D. typical 0.002%, Input Sensitivity 500mV, S.N.R. -110 dB, Size 300 x 123 x 60mm.
PRICE £40.85 + £3.50 P&P

OMP/MF 200 Mos-Fet Output power 200 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 50V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB, Size 300 x 155 x 100mm.
PRICE £64.35 + £4.00 P&P

OMP/MF 300 Mos-Fet Output power 300 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 60V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB, Size 330 x 175 x 100mm.
PRICE £81.75 + £5.00 P&P

OMP/MF 450 Mos-Fet Output power 450 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor >300, Slew Rate 75V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB, Fan Cooled, D.C. Loudspeaker Protection, 2 Second Anti-Thump Delay, Size 385 x 210 x 105mm.
PRICE £132.85 + £5.00 P&P

NOTE: MOS-FET MODULES ARE AVAILABLE IN TWO VERSIONS: STANDARD - INPUT SENS 500mV, BAND WIDTH 100KHz. PEC (PROFESSIONAL EQUIPMENT COMPATIBLE) - INPUT SENS 775mV, BAND WIDTH 50KHz. ORDER STANDARD OR PEC.



Vu METER Compatible with our four amplifiers detailed above. A very accurate visual display employing 11 L.E.D.s (7 green, 4 red) plus an additional on/off indicator. Sophisticated logic control for very fast rise and decay times. Tough moulded plastic case, with acrylic tinted front. Size 84 x 27 x 45mm.
PRICE £8.70 + 50p P&P

LOUDSPEAKERS

LARGE SELECTION OF SPECIALIST LOUDSPEAKERS AVAILABLE, INCLUDING CABINET FITTINGS, SPEAKER GRILLES, CROSS-OVERS AND HIGH POWER, HIGH FREQUENCY BULLETS AND HORNS, LARGE (A4) S.A.E. (50p STAMPED) FOR COMPLETE LIST.

P - From McKenzie Professional Series
S - From McKenzie Studio Series

McKENZIE- INSTRUMENTS, P.A., DISCO, ETC

- ALL McKENZIE UNITS 8 OHMS IMPEDANCE**
8" 100WATT P C8-100GP GEN. PURPOSE, LEAD GUITAR, EXCELLENT MID. DISCO. **PRICE £31.45 + £2.00 P&P**
RES. FREQ. 80Hz. FREQ. RESP. TO 7KHz. SENS 96dB.
10" 100WATT S C1-100GP GUITAR, VOICE, KEYBOARD, DISCO, EXCELLENT MID. **PRICE £38.89 + £2.50 P&P**
RES. FREQ. 72Hz. FREQ. RESP. TO 6KHz. SENS 97dB.
10" 200WATT S C10-200GP GUITAR, KEYB'D, DISCO, EXCELLENT HIGH POWER MID. **PRICE £53.21 + £2.50 P&P**
RES. FREQ. 69Hz. FREQ. RESP. TO 5KHz. SENS 97dB.
12" 100WATT P C12-100GP HIGH POWER GEN. PURPOSE, LEAD GUITAR, DISCO. **PRICE £40.35 + £3.50 P&P**
RES. FREQ. 49Hz. FREQ. RESP. TO 7KHz. SENS 98dB.
12" 100WATT P C12-100TC (TWIN CONE) HIGH POWER, WIDE RESPONSE, P.A., VOICE, DISCO. **PRICE £41.39 + £3.50 P&P**
RES. FREQ. 45Hz. FREQ. RESP. TO 12KHz. SENS 97dB.
12" 200WATT S C12-200B HIGH POWER BASS, KEYBOARDS, DISCO, P.A. **PRICE £71.91 + £3.50 P&P**
RES. FREQ. 45Hz. FREQ. RESP. TO 5KHz. SENS 98dB.
12" 300WATT S C12-300GP HIGH POWER BASS, LEAD GUITAR, KEYBOARDS, DISCO ETC. **PRICE £95.66 + £3.50 P&P**
RES. FREQ. 49Hz. FREQ. RESP. TO 7KHz. SENS 100dB.
15" 100WATT P C15-100BS BASS GUITAR, LOW FREQUENCY, P.A., DISCO. **PRICE £59.05 + £4.00 P&P**
RES. FREQ. 40Hz. FREQ. RESP. TO 5KHz. SENS 98dB.
15" 200WATT P C15-200BS VERY HIGH POWER BASS. **PRICE £80.57 + £4.00 P&P**
RES. FREQ. 40Hz. FREQ. RESP. TO 3KHz. SENS 98dB.
15" 250WATT S C15-250BS VERY HIGH POWER BASS. **PRICE £90.23 + £4.50 P&P**
RES. FREQ. 39Hz. FREQ. RESP. TO 4KHz. SENS 99dB.
15" 400WATT S C15-400BS VERY HIGH POWER, LOW FREQUENCY BASS. **PRICE £105.46 + £4.50 P&P**
RES. FREQ. 40Hz. FREQ. RESP. TO 4 KHz. SENS 100dB.
18" 500WATT S C18-500BS EXTREMELY HIGH POWER, LOW FREQUENCY BASS. **PRICE £174.97 + £5.00 P&P**
RES. FREQ. 27Hz. FREQ. RESP. TO 2KHz. SENS. 98dB.

EARBENDERS:- HI-FI, STUDIO, IN-CAR, ETC

- ALL EARBENDER UNITS 8 OHMS (Except EB8-50 & EB10-50 which are dual impedance tapped @ 4 & 8 ohm)**
BASS, SINGLE CONE, HIGH COMPLIANCE, ROLLED SURROUND
8" 50WATT EB8-50 DUAL IMPEDANCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR. **PRICE £8.90 + £2.00 P&P**
RES. FREQ. 40Hz. FREQ. RESP. TO 7KHz SENS 97dB.
10" 50WATT EB10-50 DUAL IMPEDANCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR. **PRICE £13.65 + £2.50 P&P**
RES. FREQ. 40Hz. FREQ. RESP. TO 5KHz. SENS. 99dB.
10" 100WATT EB10-100 BASS, HI-FI, STUDIO. **PRICE £30.39 + £3.50 P&P**
RES. FREQ. 35Hz. FREQ. RESP. TO 3KHz. SENS 96dB.
12" 100WATT EB12-100 BASS, STUDIO, HI-FI, EXCELLENT DISCO. **PRICE £42.12 + £3.50 P&P**
RES. FREQ. 26Hz. FREQ. RESP. TO 3 KHz. SENS 93dB.
FULL RANGE TWIN CONE, HIGH COMPLIANCE, ROLLED SURROUND
5 1/4" 60WATT EB5-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. **PRICE £9.99 + £1.50 P&P**
RES. FREQ. 63Hz. FREQ. RESP. TO 20KHz. SENS 92dB.
6 1/2" 60WATT EB6-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. **PRICE £10.99 + 1.50 P&P**
RES. FREQ. 38Hz. FREQ. RESP. TO 20KHz. SENS 94dB.
8" 60WATT EB8-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. **PRICE £12.99 + £1.50 P&P**
RES. FREQ. 40Hz. FREQ. RESP. TO 18KHz. SENS 89dB.
10" 60WATT EB10-60TC (TWIN CONE) HI-FI, MULTI ARRAY DISCO ETC. **PRICE £16.49 + £2.00 P&P**
RES. FREQ. 35Hz. FREQ. RESP. TO 12KHz. SENS 98dB.

TRANSMITTER HOBBY KITS

PROVEN TRANSMITTER DESIGNS INCLUDING GLASS FIBRE PRINTED CIRCUIT BOARD AND HIGH QUALITY COMPONENTS COMPLETE WITH CIRCUIT AND INSTRUCTIONS

3W TRANSMITTER 80-108MHz. VARICAP CONTROLLED PROFESSIONAL PERFORMANCE, RANGE UP TO 3 MILES. Size 38 x 123mm. SUPPLY 12V @ 0.5AMP. **PRICE £14.85 + £1.00 P&P**

FM MICRO TRANSMITTER 100-108MHz. VARICAP TUNED, COMPLETE WITH VERY SENS FET MIC, RANGE 100-300m, SIZE 56 x 46mm, SUPPLY 9V BATTERY. **PRICE £8.80 + £1.00 P&P**

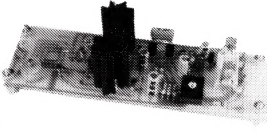


PHOTO: 3W FM TRANSMITTER

B.K. ELECTRONICS

UNITS 1 & 5 COMET WAY, SOUTHEND-ON-SEA, ESSEX. SS2 6TR.

Tel.: 0702 - 527572 Fax: 0702 - 420243

POSTAL CHARGES PER ORDER £1.00 MINIMUM. OFFICIAL ORDERS FROM SCHOOLS, COLLEGES, GOVT. BODIES, PLCs ETC. PRICES INCLUSIVE OF V.A.T. SALES COUNTER, VISA AND ACCESS ACCEPTED BY POST, PHONE OR FAX.



1992 BUYER'S GUIDE TO ELECTRONIC COMPONENTS

Maplin



Order your copy of the New MAPLIN Catalogue on sale NOW!
Pick up a copy from any WHSMITH for just £2.75 or post this coupon now to receive your copy for just £2.75 + 20p p&p. If you live outside the U.K. send £4.85 or 14 International Reply Coupons. I enclose £2.95.

Name.....

Address.....

Post Code.....

Send to Maplin Electronics,
P.O. Box 3, Rayleigh,
Essex SS6 8LR.
EE92

Over 600 product packed pages with
more than 600 brand new products
On sale now, only £2.75

Available from all branches of WHSMITH and
Maplin shops nationwide. Hundreds of new products
at super low prices